

THE CORNELL CIVIL ENGINEER

(1)

and

Transactions of the Association of Civil Engineers of Cornell University

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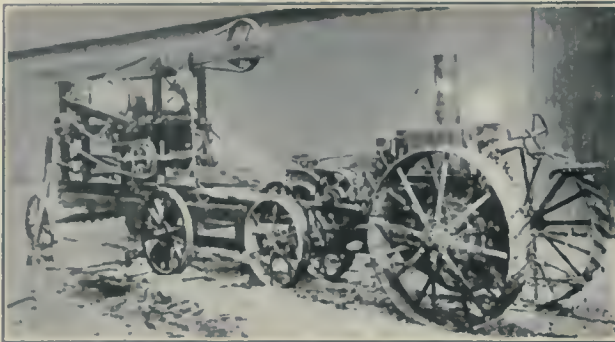
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INDUSTRIAL BUILDINGS SHOULD BE WELL LIGHTED.

From the employer's viewpoint, the big difference between men who work out of doors and those who perform tasks inside the building, is the factor of light. Daylight furnishes sufficient illumination outside during the daytime working hours for men to pursue their tasks efficiently and safely. But the proposition of getting enough daylight into the interior of industrial buildings, requires some thought.

It is not a difficult problem by any means, and any employer can take advantage of daylight and utilize it for lighting his building during the daytime, if he desires. It is an excellent light, especially suitable for the eyes, reducing eye strain and eye weariness to a minimum, and has the great economic advantage of costing nothing.

To utilize daylight to the utmost, we must first provide means for allowing daylight rays to enter the interior of buildings in sufficient quantity—namely, proper and adequate windows and skylights. Many excellent instances of buildings designed with a due regard to the importance of daylight lighting can now be seen in many of our industrial cities. Such buildings present the appearance of being practically all windows—"window walled," as they are termed—and this type of daylight construction is coming rapidly into favor, because it constitutes a more healthy building for large numbers of employes, both from the lighting and ventilation standpoints.

Among those who have constructed this type of modern industrial building may be mentioned: The Shredded Wheat Co., Gillette Safety Razor Co., Lyon & Healy Piano Co., H. J. Heinz Co., Corona Typewriter Co., Skinnors Macaroni Co., Grape Juice Co., Dodge Bros., Nelson Valve Co., Piston Ring Co., Remington Arms Co., and a great many others.

The Larkin Co., Philadelphia, has erected a building almost entirely glass, 85% being windows, and the Loomis Breaker, operated by the D. L. & W. R. R. Co., Nanticoke, Pa., is literally a glass house, being 93.5% of glass. The new buildings of the Winchester Repeating Arms Co. have an average glass area of 58%.

An investigation covering 18 buildings constructed by the Aberthaw Const. Co., Boston, shows that the average window area is 57.5%.

These figures indicate how important the subject of lighting is now considered by employers of industrial labor, and how well the idea has been carried out by the architects and engineers, in order that all parts of a building may receive sufficient daylight. But, in addition to providing ample window space, there is another factor which is equally important, and that is, equipping the windows with the proper glass.

The bright direct rays of the sun should not be permitted to strike the eye, and we must provide a means for reducing the glare to rays which will not be too bright. This is accomplished by glass especially manufactured for industrial windows, known as Factrolite. This glass possesses the property of breaking up the intense rays of the sun and diffusing the light into the interior of the building in proper portions, solving the problem of sun glare.

If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

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Vol. 29

OCTOBER, 1920

No. 1

EDITORIALS

The Value of Technical Writing to the Engineer

It is a common saying that a college degree is only the start of one's education, yet how few there are who really go into their advance study with a real idea of learning! The important points in our undergraduate training are emphasized by written reports, quizzes, or essays; but the valuable lessons of experience are not thus pointed out and it is up to the individual to select the most essential parts and emphasize them for himself. And there is no better way of accomplishing this than to express these lessons in some form of technical writing. It can be done either by gathering together all information possible and writing a textbook on the subject, or by isolating and describing separate points of interest in articles of various length for technical publications.

It is this latter form of writing that comes easiest to most engineers, and is, in many respects, the more valuable of the two types. It must almost without exception precede the preparation of a suitable textbook. Furthermore, in itself, it constitutes the best "textbook", and almost the only text, to which one has ready access after graduation. Articles appearing in technical periodicals are usually more or less narrative in form, introducing numerous illustrative examples familiar to the author and often following closely the form of a report. This is the form of writing with which engineers are most familiar and even in first attempts there is little difficulty in producing clear and conclusive articles. This form of writing, moreover, is the most desirable from the point of view of the readers of technical literature who want

Should the Teacher En- gage in the Active Practice of His Profession?

What Is YOUR Opinion?

The "Cornell Civil Engineer" is publishing short discussions of this subject giving the opinions of both the practicing engineer and the professor; we have also ventured to express editorially the viewpoint of the student. It is a subject which has not received much attention but which, nevertheless, is of interest to practically every man in the profession. We should be pleased to print any further opinions which our readers may wish to express.

their "text" concise and to the point.

There is another view which is often taken and which certainly cannot be overlooked, viz., that writing for any worthy periodical is by far the best and cheapest form of advertising. The author's name is placed before the engineering public in a position of prominence and authority, and in a way that shows he is interested in his work and the work of his profession. His article itself tells others something of what he has done and of what he has learned. This is, perhaps, a mercenary point of view to take but it is a very prevalent one and as such must needs be recognized.

A much more desirable point of view to take is to consider the advantages of mind training which the author derives from preparing his article. If he is describing a method of construction or a new type of design, he must do it in the clearest possible manner, which means that he must be absolutely clear about it in his own mind. If there are any points which are the least bit uncertain he must study them until they are not only clear to himself but also clear enough to be explained to others. All of the article must be clear and logical and it is probable that in its preparation lessons will be learned that will facilitate ease in talking as well as writing. Yet, everyone should be qualified to engage in this sort of writing, for there is no one who would admit, after even a single year in his profession, that he has learned nothing of interest and value which is not already known by the majority of his profession. Such a person would entirely lack the very necessary power of observation.

The C. E.**Honor System.**

Let's put some real pep into it this year and make the C. E. Honor System a real, live, 24 hours-a-day, idea which will fulfill its aims completely and without the aid of any artificial stimulants. Every year one scheme after another is tried in an effort to make the system more effective, and yet they are all discarded after a few month's trial. It's perfectly natural that they should be discarded, because they have all been merely surface treatments that do not ever pretend to correct the cause. The reason that the Honor System, as it is, does not succeed any better than it does, is because there is not enough college spirit back of it; get the college really interested in having a successful system and you will automatically have it. Until then all the forceful measures in the world will not have more than a temporary success.

Faculty Members in Active Practice.

The extremely inadequate salaries, which have been prevalent in the teaching profession of late years, have caused large numbers of engineering teachers to supplement their income by engaging in active practice outside of, and in addition to, their teaching. In some cases this has been carried to the extreme where more than half of the teacher's time is spent outside the University; with others however, this outside work has been confined almost entirely to the vacation periods with practically no interference with his work as a teacher. In the latter case there can be little question but that great benefit is derived by the teacher, by the student, and by the University. Every student is far more interested and impressed with the work being discussed, if the teacher can and will illustrate the various points with examples from his own practical experience. Fortunately, it is this condition which exists at Cornell and, therefore, it will be found that Cornell students have mostly praise for the teacher doing outside work. On the other hand, the teacher that shirks his University work, in order to practice in other fields for his personal gain, deserves nothing but condemnation and censure.

Is It Necessary to Have**Alumni Co-operation?**

Some of the chief factors which are encountered in publishing the CORNELL CIVIL ENGINEER are primarily of interest to our alumni. First, most of our articles are written by Cornell men. It is our desire to keep it so, for the CIVIL ENGINEER is essentially a Cornell publication edited by Cornellians and for Cornell Engineers wherever they may be.

Second, it is the only student publication that will inform you directly of the activities of the College of Civil Engineering. This should be of special interest during this present period when the long-talked-of combination with Sibley is being completed. Thus far, this has affected only this year's freshmen, but what will be the effect when the Class of 1924 really takes up its work as an integral part of the College of Civil Engineering. We want to have the solid support of our alumni to set before them as an example; if you know any who are not subscribers, get their subscription to-day. Why can't we have our alumni 100% subscribers?

Third, we are trying to improve the publication wherever we can, but we find it rather difficult to put ourselves in your position and view the periodical from your standpoint. How much easier it would be if you would only send in suggestions for us to carry out?

Fourth, and just as important as the others, is advertising. We must look to our advertising department each year to take care of a large part of our expense which, this year, is double what it ever has been. Here again we find it difficult, without the co-operation of our alumni, to get advertisements which will bring results to us as well as to our advertisers. We have space set aside for Professional Cards and we are hoping to receive an over-supply of requests for that space. Let us all work together and make this year a prosperous and successful one in every respect.

What is meant by College Spirit? To nearly every-

What is meant by College Spirit? To nearly everyone it means something, but each one interprets the term for himself.

In the College of Civil Engineering we can appreciate the term possibly better than the students of any other college can, for here we have close contact between the faculty and students. Our alumni also keep in touch with Lincoln Hall and the Cornell Society of Civil Engineers in New York is the only society of its kind formed by Cornell men. This feeling for Lincoln Hall has been fostered in the past by the meetings of the Association of Civil Engineers. This organization included faculty and students among its members and was instrumental in causing a comradely spirit to spring up. In the past few years, however, the Association has not been very active and now is practically dead. If C. E. Spirit means anything and if the intimacy between alumni, professors and students is to continue in the future, it must be revived. On the revival of the Association depends the future of the Honor System, the future of our part in inter-college spirit. Let's start the Association.

THE BAR COMPANY IN REINFORCED CONCRETE CONSTRUCTION

Purpose of Bar Companies and Reasons for Their Prominence—Estimate of Quantity and Cost—Structural Design—Standardization of Concrete Construction—Experience Offered Builders.

By WILLIAM M. RECK, C. E. '14

The large bar companies of today occupy a position in the reinforced concrete industry similar to that held by the so-called bridge companies in the structural steel trade. They do not furnish all the materials which go to make up the finished structure; but as the sizes of the members are dependent in part on the amount and placement of the steel reinforcing these companies have been compelled to assume this designing work. They employ large forces of engineers and draftsmen to design or redesign concrete frames in order to sell their product, the bars, and safely and intelligently handle this more or less new feature of structural engineering.

The present popularity of reinforced concrete is due, in part at least, to the above mentioned companies. At first long campaigns of education among engineers and architects were conducted to show the possibilities of reinforced concrete for building construction purposes. These possibilities were soon recognized because of the reduction in cost and the fire-proofing qualities of the structures. The demand grew and with it competition in the trade. This led to extensive studies which were carried on by the engineers of the companies for its more economical use in every type of structure. There resulted some very efficient, fireproof, and novel features of treating the framing of buildings, particularly. Among these might be mentioned the developments in flat-slab, or girderless floors, long-span construction for public buildings with light loads, combinations of structural steel and concrete, concrete road reinforcing, and others.

With the price of steel, in common, with everything today, continually rising the engineers of these companies are always on the search for new methods of cutting down the steel required for any given structure, without departing from fundamental theories. The demand for bars at the present time is greatly in excess of the supply or as the saying goes, "It is a sellers' market." The undreamed of use to which concrete is put is largely responsible for this. It is now used in structures of every description. Requests for steel figures have passed through this office the past year on such widely diversified propositions as factory buildings, churches, retaining walls, culverts, bridges, garages, fence-posts, prisons, and other miscellaneous structures. We are inland and as yet have not been asked to figure on ships; but when traffic increases on the Barge Canal (Erie Canal) we will no doubt be furnishing steel for and designing concrete

barges. Who will dare say to what use reinforced concrete will not be put in the future? Only a short time ago a sketch came in showing a reinforced concrete bath-tub, and I understand it has by this time been built.

One can readily see that in an office of a reinforcing bar company more than in any other known place, the development of concrete construction is followed closely and an opportunity given to see its use. The practices of these companies have become standardized in some respects. They now occupy a position of more or less authority, in that, what they do is usually recognized as good practice. As sub-contractors furnishing steel they come in very close contact with construction problems and possibilities. As structural designers for architects and engineers they must also get the owner's point of view. Finally, for themselves, they must know the most economical methods of ordering and handling steel through the mills and their warehouses. For all of these reasons their designs are the most economical to be obtained. The competition and shortage of steel keep their product, the steel, to a minimum.

The work of an engineer, or sales engineer, in an office of a bar company is varied and interesting for there are several sides to his position. It involves the preparation of estimates of tonnage requirements, and occasionally the furnishing of concrete yardage quantities, though the latter is done very little these days; from the tonnage figures the setting of the steel price for the contract; the designing of those structures which show only the beam and column sizes, and these very often rather obscurely; the layout and detailing of erection drawings; the preparation of bills of material, submitting bending and fabricating details to the shop; and scheduling the deliveries of steel to the job. This last is a task in itself with the present condition of the railroads and labor market. One is very often called upon to go out on the job and inspect it or instruct the steel men how to properly place the reinforcing. Although these latter are generally supposed to be skilled in their trade their experience is quite frequently very limited.

It will be impossible in this article to go into any or all of these above mentioned sides of the work in any great detail. Estimating and designing are without doubt the most important from the point of view of time spent on them.

It is estimating, perhaps, which calls for the

widest resourcefulness, as usually several competitive figures will be submitted on any one job of considerable size. The common types of jobs coming in for a figure are those which consist of an architect's plan, elevation, and section with the framing indicated in part or not at all. These first must be designed or framed as it will be necessary to indicate to the contractor the concrete sizes, so that he may arrive at the concrete yardage. The principal framing is laid out and the steel taken off for the footings, beams, and slabs. Of course it is impossible to go into each small part thoroughly as the time given for getting out a figure is generally very limited. The main members are designed and, after a little experience, the small parts can be approximated very closely. All the steel is listed bar by bar, assorted later into size and length, notes being made on the type of bending. The usual method is to list each member or group of members individually for columns, footings, and beams. Slab and wall steel is taken off at a pound per square foot basis, allowance being made for laps. Finally, the steel is summarized as to size of bar, weight of bent material with the type of bend, and spirals separate. Another method is to apply a pound rate per square foot or cubic foot of structure which rate is dependent upon the type of building and loading and a certain percentage of the material considered bent. This, at best, is very unsatisfactory and is only used when very great haste is demanded. In fact it is very often better not to submit a quotation at all, for the variation of this rate is considerable even in structures of the same class.

All the quantities being assembled, the next step is to price the job. This is made up of several items. To the tonnage is applied the base rate of the steel and the freight charge per cwt. All sizes under $\frac{3}{4}$ inch round have a size extra applied to them, which varies from \$.50 per cwt. for $\frac{1}{4}$ inch to \$.05 per cwt. for $\frac{5}{8}$ inch. The sum of these extensions gives the tonnage price. To this is added the cost for bending and here, too, several prices apply. The cost is so much per ton, with the price of trussed or beam bars less than half that applied to stirrups and column hoops. Spirals, being wire, take a special price from that of bars and are considered separately, either assembled or otherwise. In the case in mind, design and erection drawings will be required and this is no little cost in itself. The price of this is purely an engineering charge and is applied at either so much per ton or roughly figured on the time required to prepare the necessary designs and drawings. Finally, an overage charge is added to cover unforeseen contingencies which always occur before any piece of work is completed. It is figured as a percentage of the charges listed before, and is dependent upon the type of building, location, contractor, and judgment of the estimator.

This task of estimating is somewhat simplified by special forms for the various operations which enter into the figure and greatly by the use of calculating machines, including our old standby, the slide-rule, for rough cross checks. Each estimator will also acquire special short cuts in the various parts which seem to be better suited to his method of working and with which another would go all astray. If they arrive at the desired result that is the point to be looked at.

Practically every contract that comes into the office for which steel is required demands some designing. Some buildings we will have to design completely from footings to roof, while others involve only a substitution of sizes, by furnishing equivalent steel areas. This latter class of work is possible in two cases. The original designer had shown bars of sizes not standard such as $9/16$ inch or $7/16$ inch, or called for a wide number of sizes where the same strength could be obtained more efficiently by limiting them. Also the warehouse stock sizes must be used these days, as mill shipments are next to impossible to obtain and deliveries even worse.

In designing, no hard and fast rules can be laid down for stresses. The working stresses for concrete and steel vary for different localities, engineer's specifications, and class of contractors erecting the job. In the larger cities the building departments have set stresses by code and ordinance, which must be, and are, followed. Architects and engineers will specify, without the best judgment sometimes, the stresses to be used, while if the design originates with us and the contractor's organization is not deemed sufficiently experienced in concrete erection, lower stresses would be used than for the more experienced. Some designers fail to realize that there are on the market three grades of steel, namely, structural, intermediate and hard. Each of these varies in carbon content, ultimate tensile strength, and hence safe working stress. The hard grade steel can safely be stressed about 25% above that used for structural grade, although this is not as easily bent in the field. It is used to a considerable extent in the middle West around Chicago. Intermediate grade is the popular kind in this section of the country and is the most available at present.

In the detail of design the usual formulas for bending, shear, bond, and diagonal tension are employed, although these are simplified somewhat by the use of tables and curves. The well known curves found in the standard textbooks are practically universally used for the constants and stresses. After considerable practice one can remember these values for the common combination of stresses. The same thing may be said for slab thickness and bar spacing. The bending moment factors of mechanics apply naturally to the beams

(Continued on page VIII)

SHOULD ENGINEERS IN THE TEACHING PROFESSION ENGAGE IN PRIVATE PRACTICE IN COMPETITION WITH THEIR OWN ALUMNI?

By W. J. SHERMAN, C. E. '77, M. A. S. C. E.
Consulting Engineer, Toledo, Ohio

There is, perhaps, no great university in America where the evil conditions referred to in this article are so non-existent as at Cornell University, the writer's own Alma Mater. It is probable, therefore, no more fair minded audience can be found for a discussion of the subject selected than among the readers of the "Cornell Civil Engineer".

As proof of the writer's conviction that Cornell's record is good, let us quote from a recent letter from President Schurman on this subject, viz: "Replying to your inquiry of the 2d inst., I would say that at Cornell University all professors, including professors of engineering, are forbidden to engage in outside work, which interferes with their work here. We want them to devote their entire time and energy to their students and their study, and they do so. The operation of this rule relieves us of the evils of which you complain in some institutions."

In marked contrast to this excellent rule we have it from a most reliable authority, viz., a member of the engineering faculty of a certain large university that the dean of engineering devotes seventy-five per cent. of his time to private practice, while at the same time drawing one hundred per cent. of his salary from the university.

But this is not the worst feature. The example thus set is contagious, and it is said you can, for a consideration, divert any member of the engineering staff from his legitimate duties into private practice anywhere and for any length of time, and without detaching him from the payroll. Conscientious scruples, obligations to the Alumni, to the undergraduate students, to the parent, to the university, or to the state, are not deterrent factors. Instead, the dollars control, and the student is deprived of time, energy and talent paid for by the parent, and rightfully belonging to him, in order to gratify the teacher's cupidity.

Now let us consider for a moment the so-called arguments in favor of this practice which prevails in so many of our institutions for technical education.

1. It is said the professor needs actual practice in the field of engineering in order to become and remain an efficient teacher.

The answer to this is that no man can become and remain an efficient teacher whose heart is not devoted to the task of teaching. Frequent and prolonged absences from the class room and the campus, traveling and practicing at distant places, rendering and collecting bills for this improper service, are not conducive to the efficiency of this teaching.

There are three months of each year without university duties, though not without salary. Most institutions in addition allow the so-called Sabbatic leave of one full year in seven without duties and with full pay.

It is plainly the expectation of the university authorities generally that the teaching engineer shall devote these leaves of absence from active teaching to self-improvement so that he may function more efficiently when he returns to the class room.

2. It is said that the teaching engineer is underpaid, and cannot maintain himself and his family without more income than he receives from his salary.

The writer would be the last to begrudge him a liberal compensation for his services, but is it true that relatively speaking he is greatly underpaid? Let us compare his lot for example, with that of the preacher. It is said that the average ministerial salary in America is in the neighborhood of seven hundred dollars per annum. If this be true, it is safe to say that the average teaching engineer's income from the university or college is at least three times that amount, with three months' leave each year, one year's leave in seven, and oftentimes a pension for life after retirement from active teaching, and provision for a widow's pension besides. No such favors are shown the preacher, nor the Alumni engineers engaged in private practice.

Why then, should the members of our profession, who are engaged in teaching, be thus unduly favored at the expense of the undergraduate student, the Alumni engineers, and the university itself? As President Schurman says, "We want them to devote their entire time and energy to their students and their study."

The young graduate engineer is in much the same situation as the young lawyer or the young doctor. Without the advantage of age and experience his advancement during the early years of his practice is necessarily slow, and when there is added to this discouragement, that due to the fact that his former university teacher is actively competing with him for work which properly belongs to him, we can understand his complaint and agree with him that his lot is not a happy one.

A few years ago the writer, in an article in one of our leading technical journals, suggested a remedy for the growing evils, in substance as follows, to wit: that all fees and income from private prac-

(Continued on page 12)

ENGINEERING TEACHERS AND OUTSIDE PRACTICE

By C. L. WALKER, C. E. '04

Assistant Professor Sanitary Engineering, Cornell University

The view is expressed both within and without the ranks of the teaching profession, that teachers of engineering should not engage in outside practice. President Hollis of Worcester Polytechnic Institute in an article in *Engineering Education*, Vol. 27, 1919, entitled "Engineering Colleges and Administration," says: We have certain illusions in our schools. One of these is that a teacher of engineering is a great asset if he continues his activities in the practice of his profession. If he is a good teacher the time spent in outside business is a distinct loss to the institution with which he is connected." Others, not teaching, contend that the teacher who engages in outside work is depriving the university and the student body of his time and talent to further his own personal ends, that he really is not underpaid because the average salary of ministers is smaller than that of teachers, and that he is unprofessional and unethical.

Teachers are subject to the same human limitations that govern men in other walks of life and no doubt some can be justly accused of conduct unprofessional and unethical. In such instances, however, should not criticism be aimed at the lack of moral fibre of the individual and not at the practice of outside work? Is it proper to condemn Church or Society because of moral weakness or retrogression of a member of either institution? The average salary of ministers is pitifully small, and it is a sad comment on our present social condition that those intrusted with the task of maintaining the church and education, acknowledged generally to be two prime fundamentals in national progress, should receive such inadequate return for services rendered. "Good teachers" may spend their time to better advantage than by engaging in practice as may poor teachers, but this does not invalidate the contention that for the majority of teachers of engineering contact with practice is one of the means of making better teachers of them.

What is probably the cause of much of the complaint heard, is the abuse of the right to engage in outside work, rather than the practice itself, though that distinction is not always made in connection with criticism.

In support of the unabused practice, the writer believes the following advantages may be justly claimed:

1. The teacher is brought in contact with men who are engaged in his chosen field of effort, and benefits by the association personally. If such association was of no value one of the strongest arguments for the continued existence of many organizations would be nullified.

2. The teacher brings more enthusiasm to his classroom work, and stress on theory is more properly balanced by his familiarity with conditions of practice.

3. The student's interest is more thoroughly aroused and the effort he exerts in his work is correspondingly increased. In the article previously referred to, President Hollis says: "The only really practical advantage in a teacher's connection with outside work is that he stimulates the imagination of his students and in that way obtains from them a larger measure of effort and interest."

4. The teacher who can and does succeed in work allied to his teaching makes a more valuable man of himself. In the eyes of President Hollis this is an "illusion," but the desire of parents to place their son under the tutelage of such a man, and the desire of administrative officers to retain such a man on the teaching staff would seem to imply that it was very general. President Hadley in speaking before the Yale Alumni of Hartford, Conn., early this year, again advocated "the development of a system of part-time professorships, whereby men can do teaching and outside work at the same time." Further on he continued: "It helps the students to have their teachers something more than mere theorists. It helps the graduates to have been taught by men who know how to place them in service most effectively at the beginning of their careers. It helps the universities to have the public look to them for guidance."

John W. Cunningham, speaking before the Oregon Chapter of the American Association of Engineers on the subject of "Some problems of the Practicing Engineer," says, he "sees no objection to college and university professors undertaking outside engineering work in their spare time. They should, however, charge for it in proportion to their experience and the responsibility assumed. Such work is both legitimate and desirable to engineers when services are given without charge or fee or for a disproportionately low fee." Speaking further on this subject, he says: "A form of competition quite difficult for the practicing engineer to meet is that of the man entirely competent in his line and regularly employed on a salary, who takes occasional jobs for evening, or extra work. The right to undertake such work cannot be disputed, but the man who uses this right should not by a reduction of legitimate fees, injure the practice of that other engineer, who has office rent, stenographic services, and other over-

head charges to consider before he can count his actual profits."

Practical work is not the only agency which is conducive to producing better teachers and better teaching. Too much emphasis of this manner of development has led to just criticism of some teachers who, during university sessions, have deprived the student body of time and talent to which they were justly entitled. Such work, nevertheless, has its proper place among the various agencies which help to make the average teacher a better one, and if undertaken during the summer or holiday recesses of the college year can not call for the criticism so frequently made.

MEMORIAL CLUBHOUSE FOR ARMY AND NAVY CLUB OF AMERICA

From Emerson D. Owen, Organization Headquarters Army and Navy Club of America, 261 Madison Avenue, New York.

Leading architects of the country will be asked to submit competitive drawings of the \$3,000,000 clubhouse the Army and Navy Club of America is to build in New York in memory of the 3,500 officers who died in the war. The Memorial will be a national one, dedicated to the commissioned men in all branches of the service who made the supreme sacrifice.

Charles Dana Gibson, Edwin Howland Blashfield, Henry Bacon and Benjamin Morris with Admiral Bradley A. Fiske, president of the club form the committee appointed to select the design for the building.

Notable contributions have been made to American Art and architecture by members of the committee on design. Edwin Howland Blashfield decorated the great central dome of the Library of Congress. His war posters attracted international attention. His most recent important work was the design for the government's certificate of honor issued for every man who died or was wounded in service during the war.

The impressive Lincoln Memorial at Washington was designed by Henry Bacon. He formerly was a member of the firm of McKim, Mead & White. He is a member of the National Institute of Arts and Letters, and the National Academy of Design.

Benjamin Morris was the architect for the Junius Spencer Morgan Memorial at Hartford, the Westchester County Court House at White Plains, and is the designer of the new Cunard Building at 25 Broadway, New York. He is president of the Society of Beaux Arts Architects.

Charles Dana Gibson is known throughout the world as an illustrator. He has a wide personal acquaintance among artists and architects. "Life"

was recently purchased by Mr. Gibson and he is now its publisher.

The new clubhouse will be centrally located and will serve not only as a monument to the men who died, but also as a home for living officers, active or retired, in the army, navy or state militia. Civilians interested in the nation's defense are also eligible for associate membership.

The committee on design will decide the rules governing the competitive drawings the club will request of all the leading architects. Only tentative plans have been decided on, but interesting features of the new building are included in these.

The memorial feature will probably take the form of a central court or hall with bronze paneled walls where the names of those who made the supreme sacrifice will be engraved.

The present clubhouse at 18 Gramercy Park has long been unsuited for entertaining the hundreds of officers who annually come to New York. During the war members found it very inadequate. Naval officers of this and the other allied countries were entertained at the New York Yacht Club, but Army officers in New York during those trying days found hotels overcrowded and themselves without a home to which they could go for suitable accommodations.

Since the war the need has been even more emphasized. While enlisted men have canteens, huts and clubhouses, the officers have been without a place to go for meals, or lodgings, except the very expensive hotels. The moderate pay of our military leaders has made the cost of stopping at these hostleries almost prohibitive.

In the new clubhouse there will be at least 400 bedrooms. A large dormitory furnished with cots will also be provided for use on special occasions when the city is crowded with service men.

There also will be a large assembly hall and small rooms for meetings of patriotic societies. Women friends of members, or women relatives of the deceased men will find a dining room and reception room for their exclusive use. Other features to be found in a modern clubhouse will be included in the plans.

The club recently broadened its scope so as to include in its membership all officers, ex-officers, and all commissioned men with the allied armies during the war, numbering approximately 200,000.

Among the men recently elected to life membership are: Henry P. Davison, who is chairman of the civilian committee; Vincent Astor, lieutenant in the navy during the war; Elmer A. Sperry, inventor of the gyroscope; J. P. Morgan, Arthur Curtis James, Charles H. Sabin, Brig. Gen. Guy E. Tripp, Brig. Gen. Samuel McRoberts and others of equal prominence.

MILITARY ROADS, TRAILS AND BRIDGES, IN PANAMA

Inadequacy of the "Natural Defense" element—Only 35 Miles of Improved Roads—Military Transportation Necessities—Cutting a Trail—Construction of Temporary Roads—Timber and Concrete Bridge Construction.

By HENRY TEN HAGEN, C. E. '13, A. M. S. C. E.

Until Recently First Lieutenant, 3rd U. S. Engineers, Engaged in Highway Work in the Canal Zone

The defense of the Panama Canal has confronted officials of the War Department and Congress ever since its completion. Previous to our participation in the World War, it was the contention of the military leaders that adequate defense was provided by fortifications at the entrances to the Canal, by the construction of field fortifications at strategic points, and by the impenetrability of the virgin jungle,—with the Panama Railroad, paralleling the Canal, as a source of supply.

However, a close study of the European War showed the inadequacy of such a defense policy, and it was realized that the Army must be able to manoeuvre quickly and to be supplied readily. With the Panama Railroad cut the supply system could not be maintained, and with the local resources undeveloped, and with transportation by sea cut off, an Army would be at a loss for food. To prove the "lack of defense" element of the jungle, the then Commanding General, with 1 Company of Engineers, 1 Troop of Cavalry, 2 Mountain Artillery Companies, 4 Infantry Companies, and a Pack Train, cut his way through virgin jungle for several miles in a remarkably short period of time. After this demonstration plans for a comprehensive road system were begun.

At the present time, outside of municipalities, there are 35 miles of improved roads within a radius of 200 miles of the Canal. Eight miles of this have been built by the Republic of Panama and twenty-seven miles by the Municipal Division of the Panama Canal. Of the latter twenty miles are on the route of a proposed trans-Isthmian Highway, leaving a gap of 30 miles.

The only inland communication in the Republic of Panama is by horseback over winding native trails, cut through the jungle. These trails follow ridges and are oftentimes steep, the element of distance having been sacrificed for drainage. The native builds his trail where he won't have to wallow through mud in wet season. The native pack pony traverses these trails readily and is accustomed to steep grades and a rough footing, but the imported horse must have wider trails and reduced grades.

With our entry into the World War numerous outposts and observation posts were established. To supply these, the construction of trails was begun and, where feasible, military roads. Following this, roads had to be constructed to manoeuvre grounds. These grounds extend over sabanas, or

pasture lands, which, however, comprise a very small percentage of the total area.

After these military necessities were provided for, future needs were considered and a defensive system of permanent highways laid out. A combination of trails and temporary roads was constructed along these routes to form a basis for surveys and to serve as a source of supply during a future construction period.

Roads in this climate are subjected to a severe test because of the extreme wet and dry seasons. The dry season extends from November 15th to April 15th without any rain, so that, during this season, improved roads are thoroughly dried out, cementing properties are almost lost, and raveling results. The wet season, comprising the balance of the year, provides a vast amount of rainfall so that within a few weeks after its inception, the soil is supersaturated; cementing values are increased, but the subsoil is so saturated that very heavy sub-bases must be provided. Hence it is essential to keep to the high ground when locating a road.

Cutting a trail through virgin jungle is by no means an easy task. This trail must conform as nearly as possible to a permanent road location, and one must keep in mind the question of distance, grades, stream crossings, and minimum earthwork, and at the same time avoid low-lying country. The topography of Panama is a mass of hills and valleys, and winding water courses with no apparent regularity.

The locator was equipped with a clinometer, aneroid barometer, and compass. Distances were measured by pacing, and, due to the thick jungles, tangents were short and angle points frequent. The reconnaissance party consisted of 1 non-commissioned officer, 1 private, and 2 native laborers, engaged in cutting the way. With his destination marked on the map before him, the locator plotted each course and approximate elevations as he went along. When he arrived at his destination, his notes were plotted more accurately and possible shorter distances investigated.

With the alignment finally determined upon, construction of the trail was begun. Natives were employed in this work. First of all, the trail was cleared from 20 to 50 feet wide, roots and boulders being removed to give a smooth footing for animals, while light sidehill excavations were made to provide a level path about 3 feet wide. Stream crossings were made by fords wherever possible, and,

where the banks were too steep, native-wood bridges were constructed. These consisted of 2 or 3 stringers of 4 to 6 inch material with a flooring of smaller pieces laid crosswise and covered with twigs and dirt.

These trails were used chiefly by pack trains in supplying Army units and survey parties, but the native soon discovered that they afforded easier access and usually saw to it that they were kept cleared.

Where it was necessary to bring up supplies at a greater rate than by pack train and to move larger troop units, temporary roads had to be constructed. These roads usually followed previously constructed trails, except in cases where further reconnaissance had shown that the route could be shortened without a sacrifice of grade or drainage. This work consisted of widening the existing trail and constructing bridges.

Where it was necessary to traverse low-lying country, telford base 2 feet thick and 10 feet wide was laid with turnouts provided at advantageous points. The base was laid carefully with each stone set vertically on its broadest edge, and they were bound together by placing other stones between them to wedge them in position. This was covered with a thin layer of dirt to provide a smooth track. Ditches $2\frac{1}{2}$ feet to 3 feet deep were constructed on each side to keep the ground water level below the base of the stone.

In approaching stream crossings it was generally necessary to cross swamps. Such construction was of the corduroy type, with a 3 or 4 foot thickness of native timbers laid crosswise of the road and two 8 inch timbers laid longitudinally and 10 feet apart to provide a guardrail. The driving space was filled with stone wedged between the timbers and chinked in. This was then covered with a 4 inch layer of dirt.

Bridges were located at advantageous points where the stream banks were steep and the span short. Native timber was used in the construction, and spans of over 30 feet could not be built. Only the hard wood could be used because, as soon as cut, any wood was attacked by ants which destroyed it in a very short time, and, as straight timbers of the required length were large in diameter, there was a limit to the length of timber which could be handled with the equipment provided.

The abutments were first constructed with heavy timbers placed at right angles to the axis of the bridge and one above the other to form a batter of 12 on 1, with notches and grooves provided for timber anchors which extended longitudinally into the fill. Wings were constructed in the same manner and notched and grooved into the abutment. The stringers were snaked across the abutments by mule teams with the use of block and tackle and were spaced about 3 feet apart. With the

stringers in place, a flooring was made of 6 to 8 inch timber laid crosswise on the stringers. The interstices were filled with brush and the floor covered with a thin layer of dirt. Two guard timbers 8 inches in diameter were laid longitudinally 12 feet apart and wired to the flooring. A temporary railing 3 feet high was provided. This type of bridge carried truck loads of 10 tons without any apparent injury. Its life is from two to three years.

On more important roads this type of bridge failed because of the vibration caused by constant truck traffic. Proper fastenings could not be provided to counteract the action of vibration, and it was necessary to replace them with a concrete slab bridge. Sand, gravel, cement, and reinforcement had to be hauled by truck for several miles. Reinforcement was usually light railroad rails which had been salvaged from Canal construction dumps.

The crossing of rivers in the jungle was our hardest problem, not only because of the long hauls, but because of the lack of materials necessary for such construction. In 1917 two rivers had to be crossed, and the time allotted for construction was very small. The type adopted was built almost entirely from Panama Canal scrap. At this particular site there was an 18 foot tide, and all foundation work had to be done at low tide. Five-foot wrought iron caissons were sunk in the river bed and the slit inside excavated. This was filled with concrete and an 18 inch dredge pipe set into this to form one-half of the pier. These dredge pipes were lashed together, crosswise and longitudinally, with light railroad rails, and filled with concrete to the required height. The slab was of concrete 15 inches thick, reinforced in each direction with railroad iron. Such a bridge served its purpose well for one season and perhaps would have stood longer, had not the foundation on the further end been faulty. However, no one could determine its capacity and, when it failed a new bridge with a different type of foundation was built. In passing, it might be well to mention that another bridge of the same type also failed because of faulty foundations.

Materials for the new bridge had to be transported to the site at high tide by launch and ponton boats. It was necessary to employ a pile driver. Pier foundations were 25 feet long and 6 feet wide. Twelve piles 30 feet long were driven for each pier. These piles were capped with 5 feet of concrete, reinforced with light rails in each direction, and placed inside a cofferdam with the base of the concrete 3 feet below the stream bed.

The middle twelve feet of the piers were omitted in order to decrease the amount of material to be transported, although it was not considered an approved type of construction. However, it was thought that when the capacity of the bridge was increased, the center could be filled in with ease.

(Continued on page X)

ALBERT J. HIMES---A MEMOIR

Reprinted from American Railway Engineering Association Bulletin for June, 1920



ALBERT J. HIMES

Albert J. Himes, Valuation Engineer of the New York, Chicago and St. Louis Railroad Company, died at Cleveland, Ohio, November 4th, 1919. He was born at Oswego, N. Y., November 14th, 1864. After receiving the usual public school training in Oswego, where he graduated from the High School in 1883, he entered Cornell University, having been awarded a scholarship in a competitive examination. At Cornell he pursued the course in Civil Engineering, graduating with honor in 1887.

Immediately upon graduation he secured a position as Assistant Engineer with the Burlington and Missouri River Railroad in Nebraska, and was employed for several years on the construction of important bridges over the Missouri River at Nebraska City and Rulo. Following this service, in 1889, he was engaged as Assistant Engineer with the Fall

Brook Coal Company Railway, and spent the year 1890 on reconstruction work. After a short engagement upon surveys for an extension of the Beech Creek Railway, he accepted, in 1891, the position of City Engineer of Corning, N. Y.

He filled the position at Corning for two years, carrying forward the usual engineering work pertaining to such an office, and in addition, by special arrangement, engaged in private practice—conducting surveys for a logging railroad, as well as an eight-mile extension of the Fall Brook Railroad; and also built a dike in the Chemung River. As City Engineer he introduced for the first time at Corning the practice of laying water and sewer mains before paving, and laid the first brick pavement there.

During the three years following July, 1884, he

occupied the responsible position of Resident Engineer, Eastern Division, New York State Canals. The duties involved a variety of engineering work, including full charge of all field-work and preparation and approval of estimates for payment, as well as estimates for new appropriations. Owing to grave differences of opinion with his superiors in rank, growing out of changes in classification of material, ordered against his protest, and feeling that political pressure was being used to favor certain contractors, he resigned in 1897. In this connection the late Alfred Noble paid Mr. Himes a high tribute for his conscientious adherence to his standard of probity.

On leaving the State Canal Service he was offered and accepted the position of Assistant Engineer on Deep Waterways Surveys in New York State. This project involved a thorough study of the route for a canal from Oswego to Herkimer and included a triangulation of Oneida Lake. This work being concluded in 1899, the following months up to January, 1901, were spent on various investigations, including the Michigan Railroad appraisal under Mr. M. E. Cooley.

Mr. Himes entered the service of the New York, Chicago and St. Louis Railroad in January, 1901, as Bridge Engineer, and in this capacity designed all steel structures then being substituted for the obsolete types. This work included the design of masonry substructures, and personal attention to shop, mill and field inspection.

In January, 1907, he became Assistant Chief Engineer in charge of Second Track construction and yard enlargement, and was specially charged with provision of plans for elimination of grade crossings, in addition to bridge design.

On February 3d, 1909, he was designated to assume charge of all engineering problems involved in carrying into effect contracts with the municipalities of Cleveland and East Cleveland for the separation of street grades, which, for several miles, included four-track construction to accommodate the Cleveland Short Line Railroad.

Acting for all the interested parties, the plans were executed under an organization created by himself, all the work being done by direct labor.

This work occupied the larger part of four years, and was concluded to the entire satisfaction of the various interests, municipalities and railroads, and the complete work reflected great credit on Mr. Himes and his staff. His careful preparation and methodical exactness in plans and system of record enabled the interested parties to obtain clear and concise data and information of special value at any stage in the progress of the work.

In 1915, he was designated as Valuation Engineer in connection with other duties. He built up the organization necessary to properly accomplish the

purpose of the Valuation Act, under the rules and instructions of the Federal Valuation Division.

In this relation the same thoroughness and painstaking care was exhibited as in all other undertakings. He continued as Valuation Engineer until failing health compelled cessation from all duties.

Mr. Himes maintained a lively interest in his Alma Mater, keeping steadily in touch with its affairs and aiding by membership and leadership in its Alumni organizations the maintenance of valuable relations between the college and its graduates.

He had pride in his profession and sought by personal interest and service in the several technical societies, covering the field of his activity, to advance their dignity and influence in the public mind.

Mr. Himes joined the American Society of Civil Engineers as an Associate Member in November, 1895, becoming a Member in 1899. He treated this membership as a serious obligation and endeavored to live up to its requirements. He contributed to the Proceedings and to the discussion of papers presented by others, and all matters presented by him gave evidence of careful preparation; exactness of statement was a cardinal point.

He deprecated the use of inexact language and ever sought by example and counsel to teach young men coming under his authority the habit of exactness in language, as well as precision in work. The assembling of facts and not guesses was always a preliminary step to the proper analysis of problems.

Mr. Himes was an active member of the American Railway Engineering Association, which he joined in October, 1905.

Owing to his special fitness for such service he was elected a member of the Committee on Iron and Steel Structures in 1906 and served continuously as a member until 1917, being Chairman of the Committee from 1912 until 1917.

During his membership there was perfected improved general specifications for steel railway bridges, and collateral subjects of the highest importance were acted upon, in all of which he had a leading part, and the reports of this Committee from year to year bear the impress of his systematic thinking.

As Chairman of this Committee his ability in presenting and sustaining its conclusions in open convention, his full command of the subject under discussion, aided by logical statement carefully phrased, brought his preeminence into full recognition.

He also served as a member of the Committee on Rules and Organization in 1916 and up to the time of his death.

Mr. Himes was also an active member of the
(Continued on next page)

AVERAGE INCOMES FOR CLASS OF 1910

The "Alumni News" for August published some interesting statistics on salaries prepared by the secretary of the class of 1910, Mr. Andy Whinery. The article says, "The record will undoubtedly prove interesting to many Cornellians who have always felt that Cornell has given its students a good start in the world, but who could offer nothing tangible to support their belief."

It will also have additional interest for the engineer as the figures show them to be next to the lowest on the list, leading the teachers by only a few hundred dollars. The low ranking of the engineers is explained as probably due to the fact that nearly one-quarter of the total replies were from engineers; that explanation, however, seems hardly adequate for the following figures:

Average Incomes by Professions

| | |
|----------------------------------|----------|
| 10—Bankers and Brokers | \$11,040 |
| 36—Manufacturers | 8,524 |
| 18—Physicians | 7,944 |
| 7—Architects | 7,230 |
| 31—Merchants | 7,136 |
| 29—Lawyers | 5,905 |
| 41—Salesmen | 5,690 |
| 3—Purchasing Agents | 5,600 |
| 4—Advertising | 5,476 |
| 5—Newspaper | 5,180 |
| 5—Accounts and Statistics | 5,004 |
| 6—Insurance | 4,533 |
| 14—Farmers | 4,461 |
| 15—Builders and Contractors..... | 4,287 |
| 7—Veterinarians | 3,921 |
| 83—Engineers | 3,724 |
| 33—Teachers | 3,137 |
| <hr/> | |
| 352—Members of Class | \$5,385 |

ALBERT J. HIMES

(Continued from page 11)

Cleveland Engineering Society, which he joined in 1908, serving as its President in 1912 to 1913. He took a deep interest in its affairs and gave much time and effort to promote its growth and increase its prestige.

He believed firmly in the mission of the Engineer as a leader in the community, and, in the study of this phase of the Engineer's duty and privilege, he became convinced that the Engineer's usefulness to the community could only be increased to the degree that the public rose to an appreciation of the Engineer's qualifications.

Due to his endeavor there was started during his presidency the publicity work of the Society, which has been so highly commended by other societies all over the United States.

In furtherance of this aim to acquaint and bring home to the public the value of the Engineer's services to the community, he promoted a special publication of this Society entitled the "Conquerors." It was his belief that a high-grade magazine describing engineering achievement in language familiar to the layman, with a minimum of text and a maximum of illustration, would be widely read and of great mutual benefit in bringing a knowledge of the work of the Engineer to the non-technical public. The reception accorded the "Conquerors" proved this belief to be well founded.

As a member of the several Engineering Societies referred to, he evinced a serious interest in their general purposes, which was reflected by his contributions in the form of papers; the more noteworthy of which were published in the Bulletins of the American Railway Engineering Association. Those dealing with the "Elimination of Grade Crossings in Cleveland" and on "The Science of Organization" are especially interesting. They reflect the serious application and the systematic thinking which characterizes all of his professional work.

His other contributions were in the form of discussions—on "The Stresses in Track Fastenings," "Classification of Existing Bridges," and on "Rail-End Connections for Draw-bridges."

Mr. Himes was married February 28th, 1889, to Miss Grace Hyatt, who, with two sons and one daughter, survives him. He was a member of the Presbyterian Church at Corning, N. Y. In all of his domestic and personal relations and in his official intercourse he left a lasting impression of an entirely sincere and conscientious man. He adhered steadfastly to whatever course he marked out in any line of activity, and with rare exceptions reached the goal.

He was always "Loyal to the Job."

A. W. JOHNSTON,
Chairman,
HUNTINGTON SMITH,
GEO. H. TINKER,
HUNTER McDONALD.

SHOULD ENGINEERS IN THE TEACHING PROFESSION ENGAGE IN PRIVATE PRACTISE?

(Continued from page 5)

tice of professors during the college year he turned into the university treasury. It is safe to say that if this practice were followed and this rule enforced, there would be no complaint from any source. Needless to say, our suggestion was not received with favor by those who are profiting improperly by the unethical and unprofessional practice to which we have referred.

SUGGESTIONS FOR CONCRETE DESIGN

Types of Live Loads for Different Buildings—Influence of Union Labor on design—Three Systems of Slab Design and Their Relative Costs—Standardization of Design.

By HAROLD A. AXTELL, C. E. '11, M. A. A. E.

The first thing to be considered in designing a reinforced concrete building is the building code of the city in which the structure is located. In case there is no building code, some standard specifications for designing must be used, such as those recommended by the joint committee of the American Society of Civil Engineers.

The live loads which are to be used for a particular type of building must be determined either by the building code, or by reference to general practice. In this connection it must be determined what reduction on live loads, beams and columns is allowed. On buildings requiring smaller live loads, such as office buildings and apartment houses, there is usually allowed a reduction in live loads because the building is seldom, if ever, loaded throughout its area with the live load assumed. For buildings of this type the loads during construction probably stress on beams and slabs higher than they will ever be stressed when the building is completed. On the other hand, in designing buildings for warehouse purposes where heavy live loads are used, it is best to make no reduction as there is no foretelling how the floors might be loaded.

The case comes to the writer's mind in which a floor live load of one hundred and fifty pounds per square foot was used in a design of solid concrete flat slab construction, practically in accordance with the Chicago building code. When the building was about two years old, the question came up as to what live load had been used in the design, as the floors in some cases were heavily loaded. An investigation was made, and it was found that four or five panels along the wall were loaded with four hundred pounds per square foot over the entire area of the panels. The interior panels adjacent to the loaded ones were entirely vacant, so that there was only the weight of the slabs to resist the high negative moments in the loaded panels. The deflection of the loaded slabs could not be measured and there was no apparent sign of weakness; the ceilings had been whitewashed and there was not sufficient deflection to flake off the whitewash. This is merely to show the loads which may come on a building of this character, and that it is much more important to make no reduction in live loads than on a building of some other type.

The next things to come under consideration is the type of building in question and the purpose for which it is to be used; that is, whether it is an office building, an apartment house, a garage, or a warehouse, etc. The architectural features, such as location of partitions and vent openings, must

also be investigated thoroughly. It must also be noticed whether there is a different lay-out required on one floor than on another. In many apartment houses and office buildings it is desirable to obtain large, clear spaces on the first floor, and columns above the second floor must be supported by heavy girders at second floor level.

When the type of building and architectural lay-out have been selected it becomes necessary to determine what design will be most economical for the given case. There are several factors important in the selection of the type of design. The form work is one of the most important items, for in a concrete building this constitutes a considerable percentage of the total cost. Savings in form work are made by obtaining as much repetition as possible in the floor construction, and at the same time keeping the construction as simple as possible. There is room for much improvement in this part of reinforced concrete work, even though much has been done since this type of building first came into extensive use.

Another factor in the economical design of a floor system, and one which is becoming more and more a problem every day, is union labor. There may be different unions claiming each particular part of placing the floor system, or what is worse, there may be several unions claiming the same work. In such cases it leads to much confusion, for if one union places the material, the other one, which also claims it and the trade allied with it, will call their men off the job. For instance, for a floor which calls for a terracotta tile it is necessary to have a bricklayer,—but a rod setter must place the reinforcing steel.

If an apartment house or office building is under consideration, the columns must first be located in partitions and, if possible, in corners of rooms. At the same time it must be borne in mind that the floor lay-out must be such as to give as long a line of beams as possible, with the greatest continuity in the slabs. It is usually required that no beams will be extended into the rooms, and it is therefore necessary to use floor slabs of long spans in order to obtain the flat ceilings. The dead weight of such a floor must be kept down as much as possible, providing the cost of lightening the load does not exceed the saving in materials. The slab setting of terracotta tile blocks of required thickness placed in rows at sixteen inches on centers with two or more inches of concrete on top is much used, and is very economical. With this construction the ceiling is flat and ready for plastering. The form work

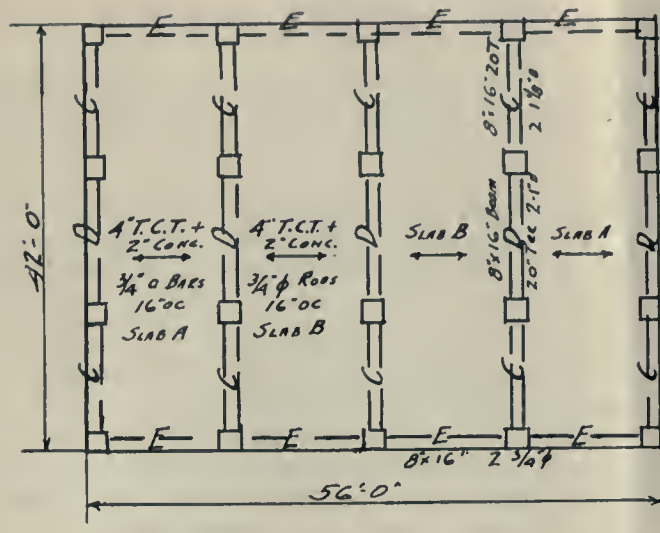
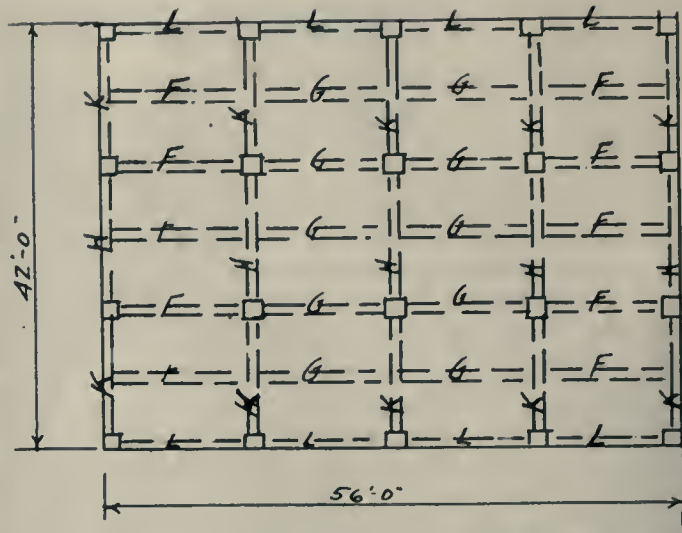


FIGURE 1

is simple, has an open deck, and can be used by merely laying down boards one inch by six inches at sixteen inches on centers. The tile being twelve inches wide a four-inch concrete joist is formed between the rows of tile, and both are supported by the form. The tees in the beams are formed by merely omitting the tile at the ends of the rows.

Another slab system, which is used very frequently, uses sheet metal arch forms from four to fourteen inches deep as may be required, and approximately twenty inches wide. These metal forms are placed in rows for forming concrete beams four or five inches wide. Two or more inches of concrete is poured on top of the arches, forming the slabs and making tees for the joists. This system saves considerable dead weight over the one mentioned before, as there is less concrete used and the weight of the tile is entirely omitted. At the same time slabs of considerable depth can be obtained. If a flat ceiling is required, it is necessary to use metal lath which, if the metal forms are to be left in place, should be placed before concreting. Often, however, the metal forms are made of heavy gage metal, so as to be removed and used an indefinite number of times. In this case it is necessary to support the metal lath after the forms are removed.

A floor system for office buildings and apartment houses, which is much in use in the city of Washington at the present time, consists of terracotta tile blocks twelve inches by twelve inches and thickness as required for the particular slab. These tiles are placed sixteen inches on center in each direction, forming a four-inch concrete beam in each direction, and the completed slab is, of course, supported on the four sides by beams or otherwise. With such a system there is usually no concrete placed on top of the tiles, but the concrete is allowed to flow into the ends of the tile, making it strong, not only in the longitudinal direction, but also in transverse direction. By so doing the



SLAB 3 1/2" SOLID CONC. 3/8" Ø @ 6 1/2" OC
3 - 3/8" Ø EACH BAY AT RT. ANGLES TO MAIN STEEL

FIGURE 2

BEAM SCHEDULE

| MARK | NOTES | DEPTH | STEEL | |
|------|-------|-------|------------|------------|
| | | | STR. | B.T. |
| F | 6 | 12 | 1-7/8" Ø | 1-7/8" Ø |
| G | 6 | 12 | 1-7/8" Ø | 1-7/8" Ø |
| H | 8 | 16 | 1-1" Ø | 1-1" Ø |
| K | 8 | 16 | 1-1 1/8" Ø | 1-1 1/8" Ø |
| L | 8 | 16 | 1-3/4" Ø | 1-3/4" Ø |

strength of the tile is figured in comparison; the slab being supported on four sides is designed as a flat plate, the maximum moment being considered on a line with the diagonal. This system is very light, as the four-inch thick slab is all that is required for apartment house loads on a base approximately fourteen feet square. The system is patented by Mr. Carl Schuster and, in comparing the cost with other systems, it is necessary to consider patent royalty; it also has an additional cost over the other ones mentioned in that it is necessary to use solid decking for slabs, and there are, of course, beams in two directions instead of one.

In determining which of the several systems is more economical, it is necessary to go into the cost of each form of construction, taking into consideration all factors such as costs of material, savings, costs of lighter loads, excess costs of labor, and number of different trades required for placing materials.

As an example for making such comparison, we will assume a floor fifty-six feet by forty-two feet, divided with columns fourteen feet on centers in each direction. We will assume a live load of fifty pounds per square foot, with ceiling and floor load of twenty-five pounds per square foot, making a total load of seventy-five pounds exclusive of slabs. We shall assume that the concrete in place costs fourteen dollars per cubic yard; steel in place costs

\$.06½ per pound; forms in place for system No. 1 \$.25 per square foot and for system No. 2 \$.27 per square foot; and for four-inch terra cotta tile in place \$.20 each. In system No. 1 we shall assume a four-inch terra cotta tile with two-inch concrete for slabs of a span of fourteen feet. System No. 1 will be as shown in diagram No. 1. The total materials and costs required would be as follows:

| | | | |
|------------------------------|---|---------|-----------|
| 36.3 cubic yards of concrete | @ | \$14.00 | \$508.20 |
| 1411 pes. 4 in. tile | @ | .20 | 282.20 |
| 6200 lbs. steel | @ | .06½ | 403.00 |
| 3200 S F Centering | @ | .25 | 800.00 |
| | | | <hr/> |
| | | | \$1993.40 |

In the design of System No. 2 it will be as shown on Diagram No. 2. The materials and costs will be as follows:

| | | | |
|------------------------------|---|---------|-----------|
| 37.5 cubic yards of concrete | @ | \$14.00 | \$ 525.00 |
| 6200 lbs. steel | @ | .06½ | 403.00 |
| 4830 S F Centering | @ | .27 | 1304.41 |
| | | | <hr/> |
| | | | \$2232.41 |

In this case it is seen that the terra cotta tile joint construction is the cheaper. The concrete and steel are the same in either case, but in System No. 2 the form work is fifty per cent more than in System No. 1. This additional centering more than offsets the cost of the terra cotta tile. It is usually necessary to make a thorough analysis of the job to determine the most economical construction; but with experience in a certain vicinity and costs not changing too rapidly, one becomes accustomed to choosing the most economical design in a particular case without analyzing each one separately. At least it is possible to sift it down to not more than two types of construction.

The writer knows of one builder who constructed for himself many apartment houses during the past few years. He has standardized as much as possible, making his slab spans and column lay-out typical for the various apartments. He has heavy metal forms as equipment and his organization is trained to this type of construction. In this case the metal lath is supported after the forms are removed. It is thus seen what might not be the most economical construction, for one particular job, may be so when several similar jobs are considered, and an organization is trained to a particular type of construction.

It must be remembered that in keeping form costs down, one of the largest factors is to obtain such a lay-out as will allow repetitions of forms. For instance a building of several floors should have the same general lay-out as far as form work is concerned, for otherwise it would be necessary to discard forms for one floor and make up an entirely new set of forms for each different floor. For this reason it is not usually economical to combine sev-

eral form systems in each building, even though it might show a saving in material.

In designing columns the same idea should be borne in mind. It is occasionally cheaper to keep the same size of column for the entire height of the building, even though the column would be much too strong at the upper story. This is true when some special condition exists, such as wide spandrel wall beams forming into the columns. It would be cheaper to keep the same width of column than to change the column size, thus making it necessary to lengthen the large spandrel beam. Otherwise if there is no restriction in size, columns should be designed for the loads which they are to carry, and as economically as possible. Under the present conditions and relative costs of concrete, steel and form work for stayed columns, the economical percentage of steel is about two per cent of the column area. Odd sizes of columns such as fifteen by fifteen inches or seventeen by seventeen inches should be avoided.

In buildings of the garage or light store type it is usually not necessary to obtain a flat ceiling. For such buildings, it is best to divide floor space up into short slab spans using solid concrete floor, supported by beams and girders. By so doing there results a large amount of extra form due to the many beams but this is compensated for by the saving in material and lightness of the structure and saving in placing of concrete.

Another economical system of such building is the removable metal forms, supported by beams as described above. This construction simplifies form and requires about the same concrete as beam and girder design.

For buildings of heavier warehouse type the saving in deadload is not so great a factor inasmuch as the columns can generally be spaced about equally in both directions. Spacing around twenty feet is generally the most economical.

If there are several floors, and columns are spaced equally in both directions, one of the various types of solid concrete is most economical. This type reduces form work except at the column heads as there are no beams. There are metal column forms and column heads for this type of construction which are generally used. This type, like all others, shows the greatest saving by repetition. For instance, if there is to be only one floor with a heavy load of 250 pounds per square foot, it would not be economical to use the flat slab design. In such a case it would probably be much better to use the beam girder design than the solid concrete slab design. The flat slab type of construction is especially desirable in buildings with heavy loads where there are several floors, especially if the live load required on one floor is different from that on another floor as the additional strength can be

(Continued on page XI)

William M. Torrance, C. E. '95

William Martin Torrance died on May 18th at Charleston, S. C., leaving his father, S. Clay Torrance of Los Angeles, Calif.; his wife, Louisa M.; and three children, Philip M., born May 4, 1905; Myra M., born March 18, 1907; and Charles M., born December 30, 1909. He also leaves three brothers; Stiles A., A. B. '94, who married Flora E. Chapman '93; Chester C., C. E. '99, M. C. E. '00; and Robert S., C. E. '16.

He was born April 4, 1874, at Gowanda, N. Y., and later attended District School there and prepared for Cornell at the Gowanda Union School and Academy.

Torrance entered the University in 1890, receiving the degree of C. E. in 1895; he was a member of the Cornell Christian Association, the Civil Engineers' Association, and the Chess Club. It was necessary for him to work his way through college in large part; in his earlier student days, he attended to furnaces, mowed lawns, and did many kinds of odd jobs, but later he sold drafting instruments to engineering students. As the agent of T. A. Altemendorf, of Philadelphia, he sold more instruments than any other student agent in any educational institution. In his senior year, he not only paid all his own expenses, but was able to save something to aid his sister Lucy to go to Cornell. She entered in 1895, and in 1899 was graduated with the degree of Ph. B. She died on September 8 of the same year.

In engineering practice he was noted for his originality in design and his freedom from bondage to precedent. When employed by the Illinois Central Railroad, he made a large number of comparative designs for bridge abutments to show the great economy of several forms which were radically different from the usual ones. His design of an arched abutment is now regarded as a modern standard type. This tendency on his part is said to have aroused jealousy occasionally on the part of higher officials who wanted their own plans carried out without being shown that economy demanded something else.

When the McAdoo tunnels, known as tubes, were built under the Hudson River, he was in charge of reinforced concrete design. At the shore where the tubes branch up and down the river it became necessary to build short sections as pneumatic caissons. Conditions were such that steel could not be secured within a year after the designs were finished. Mr. Torrance requested permission to design the caissons in reinforced concrete. It was granted. The designs were submitted to other consulting engineers for examination, and were approved. He was then appointed constructing engineer to carry out his own designs. Five caissons were built, and Mr. Torrance thus saved about half a million dollars, and over a half-year in time.

His success in this work led later to his appoint-

ment as a designing expert on the caissons for one of the Brooklyn drydocks of the U. S. Navy Yard, on which other plans had failed. His designs led to the successful construction of the drydock.

Mr. Torrance was one of the earliest engineers to design a reinforced concrete arch bridge with cantilever ends, but the conservation of municipal authorities postponed their introduction for years, because their design was considered too radical a departure from precedent. He has served not only as chief engineer and consulting engineer but also as a contractor. For the original designs mentioned above, and other successful achievements, he was elected an alumnus member of Tau Beta Pi, and of Theta Xi, by the chapters at Cornell. He was a frequent contributor to engineering periodicals and, in 1909, was awarded the Fuertes Graduate Medal for his article on "Concrete Structures in Hudson River Tunnels."

During the recent war, he served as captain in the Engineer Corps, and was on duty most of the time as assistant to the Construction Quartermaster at Raritan Arsenal, Metuchen, N. J. After the armistice he became assistant engineer with the Alphons Custodis Chimney Construction Company of New York; at the time of his death he was Vice-President and Chief Engineer for the Carson Construction Company of Savannah, Georgia.

THE STRENGTH OF CINDER CONCRETE

By H. H. SCOFIELD, M. E. '05.

Assistant Professor of Structural Engineering, Cornell University

The cinders used in making the test specimens were furnished from the heating plant of Cornell University. The following were the sizes furnished:

- (a) A quantity of run of pile cinders with fine material present. Weight 37 pounds per cubic foot (dry).
- (b) Cinders with material finer than $\frac{1}{8}$ inch screened out. Weight 28.8 pounds per cubic foot (dry).
- (c) Cinders with material finer than $\frac{1}{4}$ inch screened out. Weight 25.3 pounds per cubic foot (dry).

The proportion of material finer than $\frac{1}{4}$ inch mesh in the "run of pile" was found to be 50 per cent. The material finer than $\frac{1}{8}$ inch mesh was found to be 33 $\frac{1}{3}$ per cent of the "run of pile".

Procedure

Standard methods were followed throughout so that the results are truly comparable. The amount of water and methods of mixing were approximately those of service conditions, where hand mixing of concrete is employed. The amount of water was such as to yield a moderately dry concrete capable of being tamped into place as in practice. The pro-

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THE CORNELL CIVIL ENGINEER

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COLLEGE NOTES

Charles E. Courtney

On July 17, Cornell suffered the worst loss of the year and, in fact, of many years, for on that day Charles E. Courtney died at his summer home on Cayuga Lake. The scene of so many victories for the "Grand Old Man" was also the place of his death. He died following a stroke of apoplexy, which he suffered while alone in a boat on the lake.

Coach Courtney was born in 1849 at Union Springs, and, after very few years of school education, he became a carpenter in that town. In his early youth he became interested in rowing, and since he was nineteen years old his reputation as an oarsman and as a crew coach has never been equaled. As a sculler he won all but seven out of 134 races. Since 1883, when he became connected with the University, he has directed the crews which have made Cornell famous. He has made the name of Cornell one which brings fear into the hearts of all other crews.

His wonderful personality will surely be missed at the rowing machines and at the Inlet. Crew enthusiasts, and that includes all old Cornellians, will always remember the picture of the "Old Man" in his launch directing a winning eight twice or three times every year and watching their every move even after they cross the finish line. Of course, Cornell will get another coach, and we will all wish him great success. But none of us are so optimistic that we expect to ever find another Courtney.

CORNELL IN THE OLYMPICS

As was naturally expected, Cornell took a very prominent part in the United States victory at the Olympics at Antwerp. We all felt sure that there was nothing to it after Jack Moakley was chosen

Head Coach. And now that the results are known, we are not disappointed. The Cornellian, of whom we may well be proud, and whose performance was one of the outstanding features of the games, was Frank K. Foss, '17.

The Cornell vaulter easily took first place in the Finals by clearing the bar at 12 feet 1 inch. After some persuasion he made three attempts to establish a new record, and he finally succeeded in hurling himself over at 13 feet 5½ inches, which bettered the previous record, which he made last summer, by about 4 inches. Foss, who was captain of the 1917 track team, has been making an enviable reputation for himself since he won the Pennsylvania Relay pole vault in 1915 and the Intercollegiate Championship in 1916.

Another Cornell conquerer was C. D. Ackerley, '20, who was captain of the 1920 wrestling team. He succeeded in winning the featherweight (121 pounds) Olympic Championship and had the honor of being the only American wrestler to score. Other point-scorers were Walker Smith, '20, who took fifth place in the 110-meter high hurdles, and Ivan Dresser, '19, who was the sixth runner to cross the line in the 3,000-meter team race.

Professor

Henry S. Jacoby.

It is a great pleasure to us to be able to announce to the alumni the complete recovery of Professor Jacoby, the head of the Department of Bridge Engineering. It was during the first term last year that he suffered from a severe nervous breakdown and, as a result, gave up all his work of instructing and retired, first to Clifton Springs, and later to a farm in Pennsylvania, to rest and recuperate. Professor Jacoby is one of the best known members of the C. E. Faculty, having

written a number of books as well as numerous articles for technical magazines; the Cornell Civil Engineer has often received valuable contributions from him. We are glad to have him with us again.

Registration Figures. Because of the combination of the Engineering Colleges, it is impossible to tell just how many freshmen will be candidates for a C. E. degree.

There are now three distinct engineering courses, leading respectively to the degrees of E. E., M. E., and C. E. But all freshmen will pursue the same subjects and need not declare their intentions, as to the course desired, until the end of their first year.

This will be a decided improvement, because many men used to choose between the three courses by pulling straws, since they did not have any idea as to the one for which they were best fitted. It will now be possible also to secure an E. E. degree, whereas, formerly, those specializing in Electrical Engineering received the M. E. degree. This system also tends to develop a broader education, as all engineering students will be required to take Shop Work and Surveying.

The registration figures up to the time of the present writing are as follows:

| | |
|----------------------------|-----|
| C. E. 1921..... | 76 |
| C. E. 1922..... | 92 |
| C. E. 1923..... | 80 |
| C. E. 1924 (5 yr.)..... | 16 |
| C. E. Special | 1 |
| Combined 1924 | 470 |
| Combined 1925 (5 yr.)..... | 50 |

These figures will probably be augmented slightly during the year. Civil Engineering will probably be selected by about one-fourth of the freshmen. This would bring our total registration to about four hundred.

FOOTBALL PROSPECTS

When the football candidates registered for Fall practice, the customary jinx seemed to be on hand. First of all, John Shuler, who had been elected Captain for this year, did not return to college, because he had been placed on probation. Then after the first few days, we had quite a hospital list. Davies was injured so that he will be out of the game for good. He and Shuler were expected to be the mainstays of the team. Other injuries put out several likely candidates, but they will be patched up and ready for action very soon.

Taking it all in all, it must have been rather disappointing to "Gil" Dobie, our new coach, so it is no wonder that, when we had our first Athletic Rally in Bailey Hall, he gave what was probably the most discouraging talk that was ever heard in

that auditorium. He made us understand that we could not expect to do much with the material on hand. He also let us know that he was greatly disappointed with the small number of candidates in a University of this size. Football coaches in the past have sent us away from the rallies with the impression that there was nothing to it but Cornell, but that night we left Bailey Hall feeling as if we needed a high-powered magnifying glass to find ourselves on the map.

However, after our first game with Rochester, we felt a little better. Cornell managed to pull through with a 13 to 6 victory, after a game fight from our opponents. Although we did not get the impression that we were looking at a championship team, everyone noticed the marked improvement in both the spirit and ability of the team over that of last year. Then the following Saturday we just about swamped St. Bonaventure to the tune of 55 to 7. Cornell showed more strength than she has shown for some time. Kaw and Carey of last year's Freshman squad and Livingston of last year's Varsity gave promise of developing into a fast and clever backfield, and Munns, Finn and Guoinlock played good games at the end positions. The line also worked well in both the defense and offense. In fact, every man was putting all he had into it, to show Coach Dobie, that we would do our best to help him keep up the good record he has made with other teams. The performance of the Varsity on October 16 against Union was even more impressive than that against St. Bonaventure. Again our opponents were swamped, this time to the tune of 60 to 0. Once more did Carey and Kaw in the backfield and Munns and Brayton in the line play wonderful football.

While Dobie still seems to be dissatisfied with the outlook, we firmly believe that Cornell is not going to act as a doormat for Penn, Dartmouth and Colgate again this year. We can be expected to give them and also our new opponents, Rutgers and Columbia, a good run for their money, and although we may not beat them, they will know that they were up against a football team worthy of the name. Cornell.

This year the faculty of the College **Faculty Notes.** have inaugurated a custom borrowed from Sibley, namely of appointing assistant instructors in the laboratory and field periods from among the Graduate Students and those seniors whose averages are conspicuously high. We are pleased to announce that two members of our Senior Board have received this honor,—Mr. Chavanne, who is supervising work in the long periods in Railroad Surveying and Sophomore Work

(Continued on page IX)

ALUMNI NOTES

'75. Edward George has left the Bahamas and gone to London, England, where he may be addressed care Misses Jaret, 4 Lewin Road, Streatham Commons, London, S. W., England.

'85, '88, '97. James B. French, James H. Edwards and H. Gage Balcom are representatives of the American Society of Civil Engineers on a general committee of the American Engineering Standards Committee, working for an Anglo-American standard of structural shapes.

'78. Frank Bruen is still Cost Engineer for the Sessions Foundry Company of Bristol, Conn. His address is 69 Prospect St., Bristol.

'78. Willard Beahan, who is First Assistant Engineer for the New York Central, is now a Director of the New York Central West Branch of the American Association of Engineers. His address is Room 50, Lake Shore Building, Cleveland, Ohio.

'93. Hubert K. Bishop has resigned his position as Chief Engineer of the Indiana State Highway Department.

'93. Thomas R. Warriner is at present engaged in consulting work with offices at 324 Downs Building, Cedar Rapids, Iowa. He is especially interested in the design, inspection, and superintendence of bridges, concrete construction, paving, sewers, and water works.

'95. Norman B. Livermore has been transferred from Associate Member to Member in the American Society of Civil Engineers.

'95 MCE '98. J. S. Swindells was in Ithaca several days in September for the purpose of entering his son in Civil Engineering.

'96. DeForest Dixon notifies us that his address is changed from 71 Gates Ave., Montclair, N. J., to East Shore Road, Great Neck, Long Island. Mr. Dixon is a vice-president of The Turner Construction Company.

'97. Elroy T. Agate, an engineer with the Hydro-Electric Power Commission of Ontario, has changed his residence from 33 Evanscliffe Apartments, Toronto, Canada, to 10 Selby Street, Toronto.

'99. Calvin L. Barton has changed his address to 1328 Broadway, New York City.

MCE '99. Prof. C. C. More has changed his address to 4545 Fifth Avenue N. E., Seattle, Wash.

'00. Miss Mary Goldthwaite von Bayer, sixteen-year-old daughter of Mr. and Mrs. August von Bayer, of Wheeling, W. Va., died on May 17, 1920, after an illness of five weeks. Besides her parents, she leaves a sister, Dorothy.

'00. John C. Trautwine, 3d, has been elected a Member of the American Society of Civil Engineers. He gives his address as Box 6509, Upper Darby Branch, Philadelphia, Pa.

'01. Roger B. Williams, jr., has changed his address to 404 Riverside Drive, New York City.

'02. Robert Follanshee has been transferred from Associate Member to Member in the American Society of Civil Engineers.

'03. Arthur R. Keller is the first dean of the College of Applied Science in the University of Hawaii. Dr. Arthur L. Andrews, Cornell '93, is the dean of the College of Liberal Arts in the same institution.

'04. Mr. Arturo Monge is at present General Inspector of the Western Zone for the National Commission of Bridges and Roads of the Argentine Republic. He may be addressed at Reconquista 575, Buenos Aires, Argentine Republic, S. A.

'04- '10-'13. Elwyn E. Seelye, Consulting Engineer, has announced the formation of a partnership with Edwin A. Fraser, '10. The new firm name will be Seelye and Fraser, with offices at No. 101 Park Ave., New York City. A. L. Stevenson, '13, will have charge of the designing department.

'05. Harold F. Hamlin is General Manager of the Cuba Oil and Molasses Company, with offices at No. 515 Monzana de Gomez, Havana, Cuba.

'06, MCE '09. Grover C. Brown has been transferred from Associate Member to Member in the American Society of Civil Engineers.

'06. E. D. Burnell has changed his address to Room 604 Citizens Bank Building, Atlanta, Ga.

'06. James H. Hutchison is in the Design Division of the Estimating Section of the Du Pont Company at Wilmington, Del.

'07. Captain John P. Hurley passed the Consular Service examination in March, 1917, and upon his discharge from the army, on August 15, 1919, was appointed a Consul of Class Eight; on December 18, he was promoted to Class Seven. His first assignment was Reva, Russia, and by the direction of the Department of State, he took charge of the Consulate at Riga on February 28, 1920. He was assigned there as Consul on June 22. His home address is 119 Amerport Place, Brooklyn, N. Y.

'08. John H. Stevens has been elected Associate Member of the American Society of Civil Engineers. He is Village Engineer of Massena, N. Y.

'08. Joseph V. Hogan is now in charge of the concrete work for the naval dry dock at the League Island navy yard, Philadelphia. This is to be the largest dry dock in the United States.

'09. Arthur W. Harrington, a First Lieutenant in the Sanitary Corps, is now Assistant Construction Quartermaster at Camp Bragg, Fayetteville, N. C. He gives his mailing address at 176 Palisades Ave., Yonkers, N. Y.

'09. Isidore Walzer, who is with the New York State Highway Commission, has changed his resi-

dental address to 214 Elizabeth Ave., Hempstead, Long Island, and his office to Court House, Mineola, L. I.

'09. George F. Wiegardt has been elected a Member in the American Society of Civil Engineers.

'10. Edward V. Baron is Chief Engineer of the Priest Rapids Irrigation District, a 50,000 acre project in Washington. His address is White Bluffs, Wash.

'10. Thomas Dransfield, jr., is an engineer in the structural department of Stone and Webster, Inc., 147 Milk Street, Boston. He is married, and has two children, Thomas, 3d, aged seven, and Elizabeth, aged five. He lives at 12 Russell Street, Malden, Mass.

'10. Mr. and Mrs. Harold Hill Jones are the proud parents of a second son, Millard Burns Jones, born April 15th, at Vancouver, British Columbia. Mr. Jones is secretary and treasurer of the Lapan Logging Company of Jackson Bay, B. C.

'10. George F. Unger is Senior Draftsman and Assistant Engineer for the City Planning Committee of Buffalo, N. Y.

'11. Clarence R. Bliss has been elected an Associate Member of the American Society of Civil Engineers. He is Assistant Engineer for the Power Construction Company, Worcester, Mass.

'11. Capt. G. S. Frank is with the J. G. White Engineering Corporation at Honolulu, Hawaii.

'11. J. Raymond Hoffert is District Engineer with the Pennsylvania Department of Health, and has charge of sanitary engineering in twelve counties. He was married to Miss Ruth Baker of Harrisburg, Pa., on October 13th. The Hofferts spent several days in Ithaca on their wedding trip.

'11. James N. Irving visited the University in September, having been East to accompany Mrs. Irving and their three children back to Los Angeles. He reports that there is much activity in engineering construction on the coast.

'11. Frederick Ohrt is now City Engineer of Honolulu with offices at 20 Kapiolana Building, Honolulu.

'11. Victor Gifford Thomassen for the past year has been in charge of the engineering at the Paris offices of the United States Steel Products Co. He may be addressed at 11 Rue Edourd VII, Paris, France.

'11. Elmer E. Thompson, jr., has been elected an Associate Member in the American Society of Civil Engineers.

'11. Charles A. Volz has been appointed Chief of the Division of Light, Heat and Power of the N. Y. State Public Service Commission, Second District, Albany, N. Y.

'11. Frank M. White has been elected an Associate Member of the American Society of Civil Engineers.

'12. John Pollack Bonner of 92 Euclid Ave., Waterbury, Conn., is at present Resident Engineer on Railroad Construction for the Greenbrier & Eastern Railroad in West Virginia.

'12. Carl Crandall, a member of the faculty of the college, was married on the first of April to Miss Edna L. Northrop, of Ithaca. They are residing at 404 University Avenue, Ithaca, N. Y.

'12. Harry H. Frank has been elected an Associate Member of the American Society of Civil Engineers. He is with the Hunting-Davis Co., Century Building, Pittsburgh, Pa.

'12. The offices of Kaufman and Levine, consulting engineers, (Morris L. Kaufman and Harold J. Levine) have been moved to 56 Pine Street, Suite 1600-02, New York, on the top floor of the four-story addition to this building which they designed and supervised for the U. S. Food Products Corporation.

'12. M. M. Wyckoff was married on June 23, 1920, to Miss Sadie Britwitz at New York City. Wyckoff is General Purchasing Agent for T. A. Gillespie & Co. and allied companies at 50 Church Street.

'13. Herbert Ashford R. Austin is now First Assistant Engineer in charge of the Engineering Department of the City and County of Honolulu, T. H., with offices at No. 14 Capitol Building.

'13. Charles F. Bauer is Assistant Engineer with the Mason & Hanger Company, Gettysburg, Pa. He is now working on a 9-mile section of the Lincoln Highway which is being constructed of reinforced concrete.

'13. Frank Harold Burton, having been discharged from the army, is again in the employ of the Burton Seed & Produce Company, of 1500 Market Street, Denver, Colo.

'13. E. W. Eickelburg of 4843 Wendell Ave., Cleveland, Ohio, has changed his address to 1215 Parkwood Drive of the same city.

'13. Don Lee has been elected an Associate Member in the American Society of Civil Engineers.

'13. Henry Ten Hagen has been transferred from Junior to Associate Member in the American Society of Civil Engineers.

'13. Albert A. Ward is with the Concrete Steel Company, 42 Broadway, New York City.

'13. Charles Weiss, Assistant Supervisor of the Pennsylvania Railroad, was promoted last summer to the main line on the "busiest railroad in America" and was stationed at Irwin, Pa. In September he was made Acting Supervisor at Blairsville, Pa.

'13. Russell Dutton Welsh is at present employed as a Draftsman for the West Penn Power Company of Pittsburgh, Pa.

'14. Burton W. Brodt is with the American Autoparts Company of Detroit, Mich.

'14. M. S. Concepcion is Vice-President of the Philippine National Bank at Manila, P. I. This

bank is the official depository of the Philippine Government and Concepcion became Secretary to the President in 1918, after resigning his position as Constructing Engineer in the Department of Engineering and Public Works.

'14. Harry J. Feehan is with the Truseon Steel Company, 58 Lafayette Boulevard, Detroit, Mich.

'14. Linton Hart has been transferred from Junior to Associate Member in the Society of Civil Engineers. He is Vice-President of the Rollin Construction Corporation and may be addressed at 80 Boylston Street, Boston, Mass.

'14. Laurence Cooper Hough of East Falls Church, Va., is still an Assistant Engineer doing consulting work for the Pitometer Company of 25 Elm St., New York City.

'14. Emory W. Lane, Eastern Representative and Manager for the Morgan Engineering Company of Dayton, Ohio, has gone to Shanghai, China, to study flood control, land reclamation and water power development.

'14. James W. Routh, Director and Chief Engineer of the Rochester Bureau of Municipal Research, according to "Municipal and County Engineering," announces that he is available for service as Consulting Municipal Engineer.

'14. Alan F. Williams notifies us that his address, which was formerly P. O. Box 545, Monrovia, Calif., is now P. O. Box 144, Sausalito, Calif.

'15. Henry Gardner Lehrbach is now Lieutenant Senior Grade in the Navy, Engineer Corps. He is Supervisor of Construction of Buildings, Power Plants, Installation, etc. His present address is Box 27, Navy Yard, Charleston, S. C.

'15. Charles A. Mengers announces the birth of a son, Charles Frederick, on April 7, 1920.

'15. David N. Milhan has been transferred from Junior to Associate Member in the American Society of Civil Engineers.

'15. Herbert Ridgway has been elected an Associate Member in the American Society of Civil Engineers.

'15. Howard B. Wright has severed connections with the Sinclair Oil Co. and is now employed as an Estimating Engineer for the Semet Solvay Company at Syracuse. He may be addressed at 126 Mildred Ave.

'16. Mr. and Mrs. Edward McGuire of Wilkesburg, Pa., have announced the engagement of their daughter, Gertrude Elizabeth, to Benjamin Flagler Foote. Mr. Foote is now with the Pittsburgh-Des Moines Steel Company, Curry Building, Pittsburgh, Pa.

'16. Harmon C. Kibbe has been elected a Junior Member of the American Society of Civil Engineers.

He is now a draftsman for the State of California at San Francisco.

'16. Arthur F. Perry, jr., is now located at 1202 Riverside Ave., Jacksonville, Fla.

'17. Mr. and Mrs. James Elmore Smith announce the marriage of their daughter, Catherine Elizabeth, to Joseph Paul Blundon on August 3, at Cleveland, Ohio. Mr. Blundon is County Engineer of Boone County, West Virginia. The couple will make their home at Madison, W. Va.

'17. Harold G. Miller has changed his address to 512 Greenwich St., Reading, Pa.

'17. Mr. and Mrs. Edwin L. Scott of Scranton, Pa., announce the engagement of their daughter, Anna Gertrude, to John F. Hardecker, 8415 Manor Ave., Woodhaven, N. Y.

'17. Goichi Nakamoto was married on July 1, 1920, to Miss Yukino Uno at Honolulu, T. H.

'17. John O. Preston has been transferred from Junior to Associate Member in the American Society of Civil Engineers.

'18. Juan M. Bertran was married during the summer to Miss Pilar Margarido Hudo. They are living at Ensenada, Puerto Rico.

'18, MCE '20. Percy S. Wilson is an Assistant Engineer with the National Aniline Chemical Company of Buffalo, N. Y. Thomas H. McKaig, '13, and Clarence E. Forster, '15, are with the same company, the former as engineer in charge of buildings.

'19. Willard S. Foster has been elected a Junior in the American Society of Civil Engineers.

'19. Floyd W. Hough has been elected a Junior in the American Society of Civil Engineers.

'19. J. B. Woodbury has been elected a Junior in the American Society of Civil Engineers.

'19. Curtis B. Bennett has been elected a Junior Member of the American Society of Civil Engineers. He is Junior Assistant Engineer of the Cleveland Railway Company, at Cleveland, Ohio.

'19. Leonard Miseall is at present an instructor in engineering drawing at the University of Illinois at Urbana, Ill.

'19. Arthur W. Winship has a position on a sugar plantation at Lahaina, Maui, T. H.

'20. B. J. Harrison is engineer with the Cutler Hammer Company at Milwaukee, Wis.

MCE '20. I. Hsiang Pei is with the Miami Conservatory District at Englewood, Ohio.

'20. Lacy L. Shirey is Assistant on Engineer Corps, Cleveland, Cincinnati, Chicago & St. Louis Railroad, Indianapolis, Ind.

'20. Marcus Sorokin is in the M. of W. Department of the Pennsylvania Railroad at Pittsburgh, Pa.

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THE BAR COMPANY IN REINFORCED CONCRETE CONSTRUCTION

(Continued from page 4)

and slabs. Those for continuity, $1/12$ Wl, and semi-continuity, $1/10$ Wl, are as common as the formula for simple beams, $1/8$ Wl. This continuity over supports is a great advantage in reducing the bending moment at the center of the span, remembering however, that a negative moment occurs over the support. A concrete structure when completed and loaded is one monolithic mass and due consideration is given this when designing. This cannot generally be said of other building materials.

The most highly specialized design in reinforced concrete today is the flat-slab or girderless floor construction. This requires considerable experience to design. There are several methods of placing the steel, figuring the stresses in steel and concrete, and generally handling this most modern feature of building framing. Some of the larger cities have established codes for buildings coming under their jurisdiction, and considerable time in the study of flat-slab has been spent by committees of the larger engineering societies. All of these have made recommendations, no two of which agree. The most thorough treatise on the various codes, systems and rulings, to be made public is contained in an article, written by Walter S. Edge, C. E. '03, in the recent edition of Hool and Johnson's Concrete Engineers Handbook. This article makes certain recommendations which appear to the writer to be very logical and consistent with the best practice. It is not well for one who has not had some experience in flat-slab work, however, to attempt to design alone. There are various great economies which can be effected that are only appreciated by those who have had to do with this feature of building design.

Concrete construction is becoming more standardized every day in form-work, bar sizes, and beam and column sizes. There are two or three systems of standard forms on the market for buildings, and a movement has been started to establish more uniform beam, column and slab sizes. This no doubt will eventually be accomplished. The greatest move in standardization has taken place in the bar industry itself, which was caused by trying conditions at the steel mills. It has resulted in a limiting of the sizes of bars carried normally in stock by bar companies to the 10 following:

| | |
|-------------------|----------------------------|
| $3/8$ inch Round | $7/8$ inch Round |
| $1/2$ inch Round | 1 inch Round |
| $1/2$ inch Square | 1 inch Square |
| $5/8$ inch Round | $1\frac{1}{8}$ inch Square |
| $3/4$ inch Round | $1\frac{1}{4}$ inch Square |

These sizes are based on the areas furnished by plain bars, and therefore deformed bars will be of areas equivalent to them.

A close study of this list will show that a wide assortment is obtained which still will not lead to the

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necessity of unduly over designing in steel. It is strongly recommended that for any prompt deliveries this list be adhered to strictly. This will result in great economies in the mill, warehouse, and even on the job.

Troubles and costs increase with the number of sizes called for and the small variations in bar sizes are very confusing to the erectors. This list will cause small excess weights in places, but is this not also true among the stock sizes of steel shapes? The steel area economically required can be furnished from this list more closely than that obtained in standard warehouse structural steel shapes. Standardization is the rule for efficient work today and this is a step for concrete construction in the right direction.

The experience obtained in a bar company office is much greater than the rank and file of engineers and architects appreciate. If these companies were consulted oftener when a concrete frame is to be designed and erected, great savings would result to the architect, contractor, bar company itself, and the ultimate user, the owner. These companies are always ready and willing to be consulted by any prospective builder, and framing plans will be made on a fee basis similar to the usual building plans furnished by architects and engineers. It is not the purpose to compete with the engineers and architects, but to assist them in their problems in concrete to the mutual advantage of all.

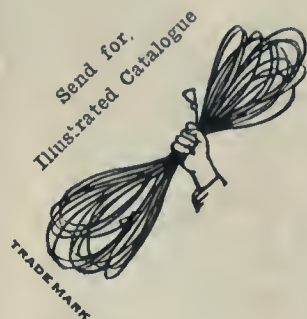
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STRENGTH OF CINDER CONCRETE

(Continued from page 16)

portions used are by volume measurements. The specimens were tested at the end of 35 days storage in moist air.

The Results of the Tests

| ITEM | Wt. of Concrete (lb. per cu. ft.) | Strength at 35 days. | Strength as % of 1:4:8 crushed stone concrete. |
|---|-----------------------------------|----------------------|--|
| (1) 1 to 8 "Run of the Pile" | 68.8 | 222 | 26.2 |
| (2) 1:2:8 sand and cinders coarser than 1/4" mesh | 78.2 | 258 | 30.5 |
| (3) 1:4:8 sand and cinders coarser than 1/4" mesh | 100.0 | 518 | 61.3 |
| (4) 1 to 10 "Run of Pile" | 61.9 | 144 | 17.0 |
| (5) 1 to 10 cinders coarser than 1/4" mesh | 64.0 | 197 | 23.3 |
| (6) 1:2:6: 10 sand and cinders coarser than 1/4" mesh | 96.0 | 539 | 63.6 |
| (7) 1:4:8 crushed stone, sand concrete | 137.8 | 847 | 100.0 |

Note: Each result is the average of tests upon three specimens 6 inches in diameter and 12 inches in height.

Discussion.

Items (4) and (5) would seem to indicate that there is a benefit to be derived by the removal of the fine material in the cinders, although the effect is of little practical importance.

Where the removal of the fine material is ac-

complished by replacing with bank sand a very considerable benefit is shown, as in items (1), (2), (3) and (4), (5), (6).

This is particularly evident in items (3) and (6) where in each case the amount of sand just replaces the finer material of cinders screened out.

As compared with crushed stone-sand-concrete, proportions 1:4:8 (Item No. 7), it is seen that the cinder concrete has a fair proportion of the strength of the stone concrete made and tested under the same conditions.

Commercial cinder concrete, using sand, in the proportions 1:2:5 gave at age 1 month 507 pounds per square inch when hand mixed. (Strahan & Perine in Eng. News, Vol. 70, p. 722). This was cinder concrete used for floors in New York City.

(Continued from page 18)

in the Materials Laboratory, and Mr. Chobot who is supervising work in the Freshman Surveying Field Periods. Other assistant instructors on the staff are,—Mr. Collum who supervises work in the Concrete Construction Laboratory and computation work in Junior Bridges, Mr. Williams who is also supervising Freshman Surveying Field Periods, and Mr. Odeyssey who is supervising Freshman Drawing.

(Continued on page XI)

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MILITARY ROADS, TRAILS AND BRIDGES IN THE PANAMA CANAL ZONE

(Continued from page 9)

The ends of the pier were 6 feet long and 5 feet wide and pointed up and down stream. They were connected at the top with three 10 inch I-beams, encased in 18 inches of concrete. The floor system consisted of two 18 inch I-beams encased in concrete with an 8 inch concrete slab, reinforced with 1 inch square twisted bars placed at right angles to the axis of the bridge and spaced 8 inches c. to c. The roadway was 10 feet wide with a concrete parapet 12 inches wide and 12 inches high and pipe railing on each side.

When one realizes what an important part roads played toward the success of the Allies in France, and what a factor they are in civilization, and development of resources, he can't help feeling a certain lack of security on the Canal Zone due to the non-existence of this important type of communication. Up to this time the work has been carried on by emergency appropriations from Congress. Recently funds were set aside for surveys. The Panama Canal is such a wonderful specimen of human endeavor and has such a commercial advantage that no effort, tending toward its defense and the development of its contiguous territory, should be spared.

This work is being carried on under the able direction of Col. C. S. Riche, Corps of Engineers,

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SUGGESTIONS FOR CONCRETE DESIGN

(Continued from page 15)

obtained by adding thickness to the slabs and not increasing the forms in any way. If there are several floors and roof, it is usually best to use the long flat slab construction even though a light roof load would not require this construction. This is done to avoid making up another set of forms for the one slab.

(Continued from page IX)

Intercollege Athletics. Last year intercollege athletics were resumed under the leadership of H. B. Ortner '18. In addition to the intercollege walk and cross-country races which are held annually, we had intercollege gridiron, soccer, track, crew, and baseball. In basketball alone did the C. E. College show up well. This failure to show up well in intercollege competition is not due to the lack of ability as much as to the lack of interest. A few years ago the C. E. College won trophies regularly but lately no new cup or banner has appeared in the library. Aside from the personal benefit derived from participation in the various sports the man who goes out for the team helps the coaches to discover any hidden varsity material and in this way adds in building Cornell Teams. This year we can start in fresh and produce teams that will be on a par with those of other colleges. Let's do it.

Interfraternity Athletics. This year it has been planned to have interfraternity soccer, gridiron, basketball, and baseball. In previous year the fraternities have had a baseball league but during the fall there has been nothing for them. This year they have started a soccer league and, with a trip to the Penn game on Thanksgiving for the winner as an inducement, considerable interest has been aroused. Intercollege and interfraternity athletics have been aroused. Intercollege and interfraternity athletics have been planned with view of getting men interested in sport who would not go out for Varsity teams and who would not indulge in any athletics if these other ways were not open to them. The coaches of all the teams and the graduate manager are all desirous that every student will back these sports and help to develop winning teams at Cornell.

Soccer. This year soccer is being taken up in the fall to a greater extent than ever before.

Matches have been arranged with many of the leading colleges in the East. On October 29 the team will make its first trip, when it will play Harvard. A squad of about fifty men is out under the direction of Coach Bawlf, and he states that the material at hand is very promising and that the team stands good prospects of winning the Intercollegiate. Practice is being held every afternoon from 3 to 6 on Upper Alumni Field.

THE CORNELL CIVIL ENGINEER

and

Transactions of the Association of Civil Engineers of Cornell University

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Vol. 29

NOVEMBER, 1920

No. 2

EDITORIALS

SHOULD THE ENGINEER HAVE A MORE LIBERAL EDUCATION What Do You Think?

We have ventured to again revive the chestnut of a liberal education for engineers representing what we believe is the average viewpoint of the student. It is a subject which must be of interest to every engineer as it enters so largely into his income. The Cornell Civil Engineer will be pleased to hear from any of its readers, either students or alumni, including YOU, and will be glad to print any opinions ventured upon the subject. Everyone must have some opinion upon this subject—Don't be bashful!

A BROADER EDUCATION FOR ENGINEERS

This subject is an old chestnut—one which comes up for discussion every few years as regularly as the sun comes up every morning and sets every night. It is, however, a particularly pertinent subject to discuss at the present time when the revision of the present course during the process of combining the colleges is anticipated by many.

At the present time a Civil Engineering student is allowed but nine hours of non-technical electives during his entire four years' course. This means that he may take but nine hours of work in the Arts College of what might be called liberal electives outside of the required course in Political Economy and the one in Public Speaking.

There can be but little doubt that an engineer will benefit greatly in his post-college career if he is able to mingle on an equal footing intellectually with business men and with leaders of the day. The engineer can no longer be a recluse living by himself and studying and working by himself. The day of the engineer who lives and works in the wilds out on the borders of civilization is in this country largely a thing of the past. The engineer of to-day is a business man. We have heard engineers advise that engineering students take as much

work as they can in business law, accounting, political economy and such allied courses. They say that an engineer must be able to meet business men and politicians on an equal footing.

There are three ways in which this broader training of engineers may be accomplished, which to our mind are feasible. The first of these is self-education, accomplished voluntarily by the student, by the aid of a library home use permit, diligent and careful study of carefully selected books and general discussion either with fellow students or with professors. Practically any professor would be glad to suggest suitable books to the student for this outside work.

The second plan is to allow more of the senior elective hours, if indeed not all of them, to be taken in non-technical electives. The great advantage in this plan is that it would allow a much more flexible schedule than at present. Those wishing to spend more time in Arts than is possible under the present system could do so, while those wishing to spend their time in specializing in this college would also be accommodated.

The third plan and probably the most logical one, since the first plan involves a great deal of will power on the part of the student to spend his leisure hours

in reading, and the second means the foregoing of a great deal of valuable work in the engineering line, is the six-year course. Some of the colleges have seen the logic of the six-year course and have made it compulsory, others have made it optional. In the latter class is Cornell. We have spoken above of the advantages of such a plan. The greatest disadvantage of such a plan is the additional strain on the student's pocketbook. The strain is hard enough on those who do not have to work their way through college, but on him who is working his way the idea of a six-year course must seem like utter foolishness, and it is to this class of men that a college education often means the most. It is these men who would be the goats, so to speak, with a compulsory six-year course. Moreover, this plan would bar many men from college who are here solely because of scholarships they have won. These state scholarships are good for but four years, and a six-year required course would mean that many of these scholarship holders would no longer enter the college.

It is a thing to be noted that more and more work is being taken by students of the college in the Arts College. They realize that while they are at the college mainly to gain an engineering education, to be a success in life they must have besides their engineering education the fundamentals of a sound business training.

ARTICLES FROM STUDENTS

Somewhere, somehow, sometime the idea has arisen and spread that the Cornell Civil Engineer does not accept articles from students. Far be it from us to have made or even sanctioned such a statement. On the contrary we will be glad to receive articles from any students interested enough to write them, and we will print them willingly provided only that they are of such a nature that they will interest the majority of our readers. In the larger sense of the word, engineers in practice, as well as those potential engineers in college, are students. The only difference between the two classes is that, while the latter are in a recognized inter-collegiate institution, the former are taking a post-graduate course in the "College of Hard Knoeks."

WE HAVE WITH US IN THIS ISSUE

We are publishing in this issue an article on the Highway System in California. The article deals with California's system of roads, the organization and administration of the Highway Department and the Department's work and expectations, and with a short description of the construction of the roads themselves. California Highways are known throughout the United States for their excellence and we are very fortunate in being able to present

to our readers at this time an article on the subject by someone on the "inside." It is to be hoped that other states will follow the lead of California and organize such a Department as California has and institute some such comprehensive construction and maintenance as she has. In time of war a network of good roads such as exists in California extending from coast to coast and from Canada to the Gulf would be well nigh invaluable. Let us hope that other states not having such an organization as California has will soon follow in her foot steps. Who was it that said, "In time of peace prepare for war?"

The report of the chief engineer of the annual summer survey camp appears elsewhere in this issue. The report is especially to be commended both for the subject matter it contains and for the manner in which it is presented. It is to be regretted that heretofore many of the reports have been dashed off without too nice a regard for accuracy and without the inclusion of those statistics which, while they were common knowledge to those in the camp, would be of interest to those not connected with the camp and not knowing over-much about its work. The report this year contains much novel material and in this respect is very good.

The article by Mr. Havens and Mr. Gascoigne on the Disposal of Cleveland Sewage is a very interesting and instructive one. It is interesting to note that ample means is provided for the future enlargement of the city with the consequent increase in the amount of sewage to be handled. No matter what sort of municipal work is being done the planning for the future growth of the city is of prime importance. The trouble that Cleveland has had in regard to floating sewage is one that has been encountered in a great many of the cities on the Lakes. The description of the concrete pipe should prove interesting to all sanitary engineers as should the comparison in costs between the steel and concrete pipes. The description of the joints used in the concrete pipes in order to obtain less leakage should prove of great value to anyone engaged in similar work.

We also take pleasure in presenting to our readers a Statistical Analysis of the Central Electric Station Industry of Canada. This industry is one of the most rapidly growing ones in Canada at the present time. The article deals briefly with the equipment involved, the number of employees and the salaries paid them, the amount of money invested in the enterprise, and the amount of power supplied. The article should prove of great interest to any of our readers engaged in this class of work.

CLEVELAND'S SUBMERGED OUTFALLS FOR THE DISPERSION OF SEWAGE INTO LAKE ERIE

Manufacture and Installation of Steel and Concrete Pipe—Allowable Leakage—Conditions Observed About Outlets—Types of Outlets.

By GEORGE B. GASCOIGNE* and WILLIAM L. HAVENS**

The practice of discharging the sewage of large cities into bodies of water, while affording a ready means of disposal, must be given careful consideration as the volume of sewage increases. This is necessary since it is desirable to prevent unsightliness and odors due to floating and decomposing sewage matter and in many cases, it is essential as a public health measure, to protect bathing beaches and public water supplies from pollution. Extensive study has recently been given this problem by various cities among which may be mentioned, Toronto, Canada; Rochester, N. Y.; Detroit, Mich.; Milwaukee, Wis.; Chicago, Ill.; Lakewood, Ohio; and Cleveland, Ohio.

The problem at Cleveland is especially important since provision has been made for the discharge into Lake Erie of the sewage from practically three-fourths (3-4) of the total population of the metropolitan area. Under present conditions this represents a normal sewage flow of approximately 100,000,000 gallons each day, and in 1960 is estimated to amount to 300,000,000 gallons daily. This quantity of sewage must, therefore, be so disposed of in the lake water that not only will there be no menace to the public health either from the pollution of bathing beach waters or from the contamination of the water supply, but also that sentimental objections due to odors, discoloration of the lake water and the presence of oily areas or of floating solids in the vicinity of the outlet will be kept to a minimum. As shown by the accompanying map (Fig. 1) the points of discharge of the intercepting sewers which serve the two lake front areas are each distant less than a mile from large public bathing beaches, while the so-called Westerly outfall discharges approximately four (4) miles from the present water-works intakes.

In order to accomplish the desired results, considerable time and study have been given to the most satisfactory method by which complete dispersion of the sewage into the lake water would be obtained. From a construction standpoint, as well as from a consideration of the results obtained, these studies may be summarized under the following headings:

The manufacture and installation of steel and concrete pipe.

The allowable leakage for submerged outfalls.

The type of outlet at the point of discharge.

Conditions observed about various submerged outlets.

Manufacture and Installation of Steel and Concrete Pipe

The first submerged outfall in Cleveland was placed in operation in 1912 at the East 140th Street outlet and was designed to discharge at a single point about 2,600 feet off shore and in about 25 feet of water. This outlet pipe, 63 inches in diameter, was made of riveted steel boiler plate, dipped in a preservative coating as a protection against rust and acid. The pipe was delivered by the manufacturer in 50-foot lengths, with a heavy angle-iron flange riveted on each end. At the dock these 50-foot sections were assembled into lengths of 150 feet, which were bulkheaded at the ends and then towed a distance of about eight (8) miles to the location for the pipe line. Openings were then made in the bulkheads and each section of pipe was allowed to fill slowly, gradually settling into its proper place. After the pipe has been lowered a diver connected the 150-foot sections by means of a special submarine joint, as shown in Fig. 2. The pipe was laid on an even grade in a trench excavated in the lake bottom and terminates in a single outlet approximately 25 feet beneath the water's surface. This outlet consists of an upturned ell, and is protected by a caisson surrounded by rip-rap.

The second submerged outfall pipe to be constructed in Cleveland was installed at the West 58th Street outlet in 1916. The shore end of this pipe consists of 400 lineal feet of 72-inch concrete pipe with cast-iron flanges, the pipe being carried on timbers between the piles supporting the storm overflow channel. At the end of this section there is a 72-inch by 60-inch by 60-inch cast iron Y and from one branch of this Y extends a 60-inch line of riveted steel pipe 2,200 feet in length. The other 60-inch branch of the Y was bulkheaded and provides for the future installation of a similar pipe line. From the end of the 60-inch line there extends 1,000 feet of steel pipe, tapering gradually from 60 inches to 24 inches in diameter and along this tapered section are openings 6 3-4 inches in diameter, staggered on 7 1-2 foot centers. This pipe was laid in a trench excavated in the lake bottom and terminates in a cast-iron flap gate, so weighted as to insure maxi-

* Sanitary Engineer, Sub-Division of Sewage Disposal, City of Cleveland, Ohio.

** Assistant Sanitary Engineer, Sub-Division of Sewage Disposal, City of Cleveland, Ohio.



Figure 1.

mum use of the multiple outlets, under all conditions of flow. The average depth of the openings beneath the water's surface is approximately 30 feet.

The third submerged outlet to be constructed was completed in 1918 and was laid in a trench parallel to and approximately 150 feet distant from the steel pipe installed at the Easterly site in 1912. This pipe is 84 inches in diameter and was made of reinforced concrete having a wall thickness of 8 inches. The pipe was cast in 20-foot lengths, each section weighing approximately 25 tons. A concrete bell and spigot, cast to a hemispherical curve, was formed on the ends of each pipe by the use of cast iron forms specially machined. These castings were placed in the bottom of the pipe forms and the concrete of the pipe shell poured upon them. Two holes were left in the concrete about 8 inches from each end of the pipe, into which were later wedged eye-bolts which were bolted together after the pipe was in place. The 20-foot sections were cast on end in steel forms and after the concrete had hardened sufficiently, were turned on side, loaded upon

seows and towed a distance of about ten (10) miles to the outlet trench. Each section was lowered in place by means of an A-frame so mounted that it could be swung out over the end of the seow and from which the pipe was suspended in double loops of cable. As soon as the trench had been excavated to grade, the pipe was lowered and the directions for moving it in order to engage with the spigot end of the pipe already in place, were telephoned by a diver to his attendant on the seow. In order to maintain a uniform grade for the pipe line it was often found necessary to support an end of a pipe on concrete blocking or to remove obstructions in the trench by means of a water jet handled by the diver. When the pipe was brought to correct line and grade, the diver inserted 1 1/4 inch tie-bolts about four (4) feet long through the eye-bolts on either side of the pipe line and these bolts were tightened by means of a ratchet wrench, hand-operated from a float. Each joint was inspected by the diver and in cases where oakum was used, the joint was calked from the inside before another pipe was lowered in place.

The total length of this concrete submerged outlet is 3,200 feet, of which the last one thousand feet consists of a section tapering from 84 inches to 48 inches in diameter. Along this tapered section there are 150 8-inch openings staggered on 6 1-2 foot centers, the axes of the openings being up-turned 45 degrees with the horizontal. These port-holes (Fig. 3) were cast in the pipe by means of wooden forms, the concrete being carefully finished to obtain a smooth round orifice. The depth beneath the water's surface of the several points of discharge averages approximately 30 feet. The pipe was laid on an even grade in a trench excavated in the lake bottom and terminates in a 48-inch flap gate so designed as to remain closed except when the flow of sewage exceeds the capacity of the multiple outlets along the tapered section. Details of the pipe and of the submarine joints are shown in Fig. 4.

The substitution of concrete for steel in the construction of the second submerged outlet at the Easterly site was not made as the result of any superior qualities of the materials as such, but was rather a measure of economy and expediency. At the time the second pipe line was proposed (1917) steel in any form was difficult to obtain and consequently, the price bid per lineal foot for steel was approximately twice that submitted for the equivalent

size of concrete pipe. In regard to the relative merits of the two materials, specific requirements and specific handling and laying facilities would no doubt be the deciding factors in nearly every installation, provided conditions were such that prices were at all comparable. While with ordinary precautions observed in laying either type of pipe, the flanged joint used for steel pipe will probably result in less leakage than the bell and spigot joint used for concrete, it should be emphasized that the importance of this factor would depend upon the use and location of the pipe line. It is safe to assume that the concrete bell and spigot pipe would not ordinarily be suitable for a high pressure line although the actual leakage on this particular pipe amounted to slightly less than one cubic foot per minute per joint, when tested under six (6) feet of static head. The difference in durability of the two materials would probably be negligible except in the case of sewage carrying an exceedingly high percentage of acid industrial wastes. Another advantage in the use of concrete lies in the carrying capacities of the two pipes and especially is this true if steel forms are used and care is exercised in the making and pouring of the concrete. It may be said, however, that due to the greater weight of the concrete pipe and to the consequent difficulties in handling and laying the heavier sections, a given

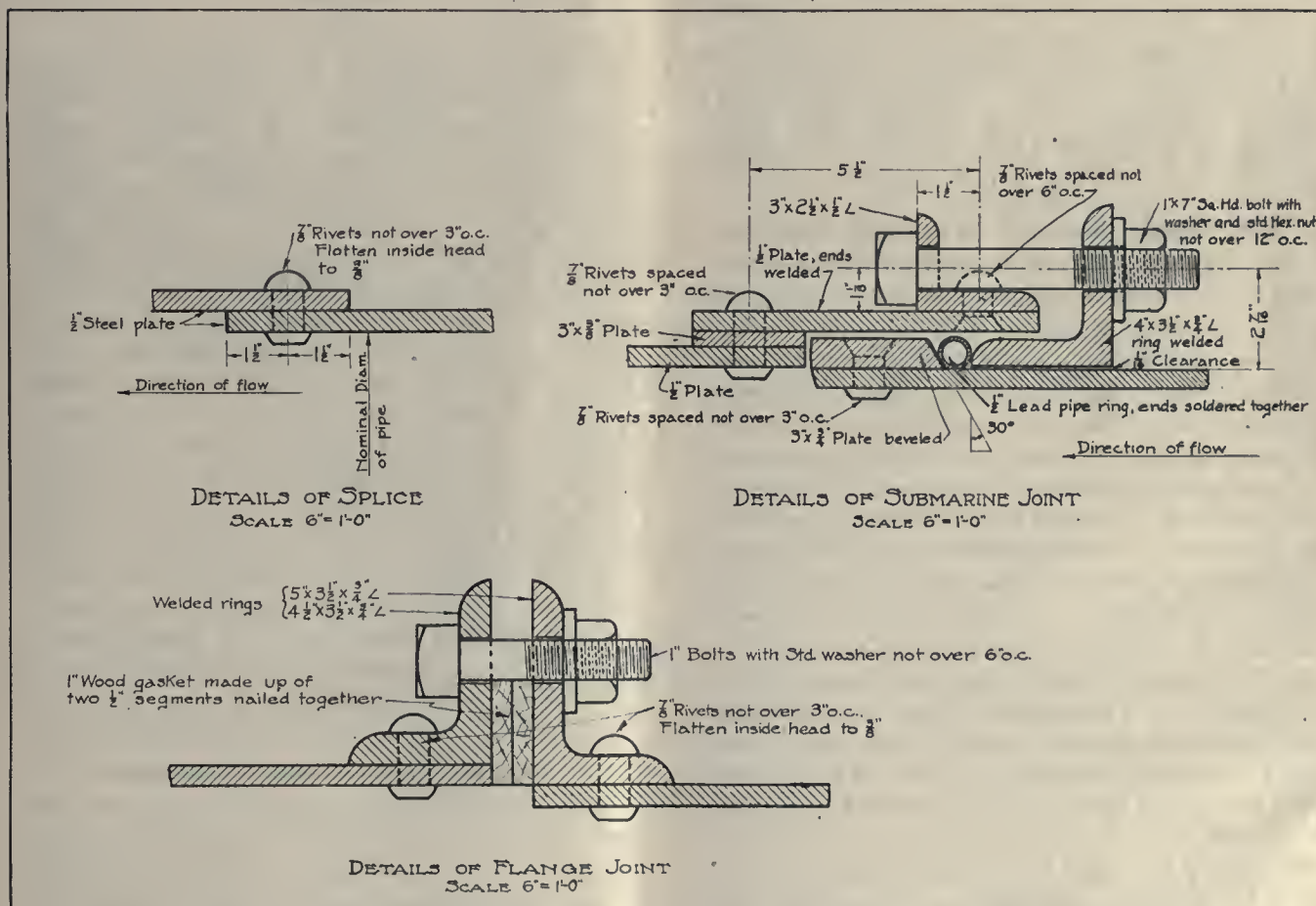


Fig. 2—Details of 63-inch Riveted Steel Pipe.

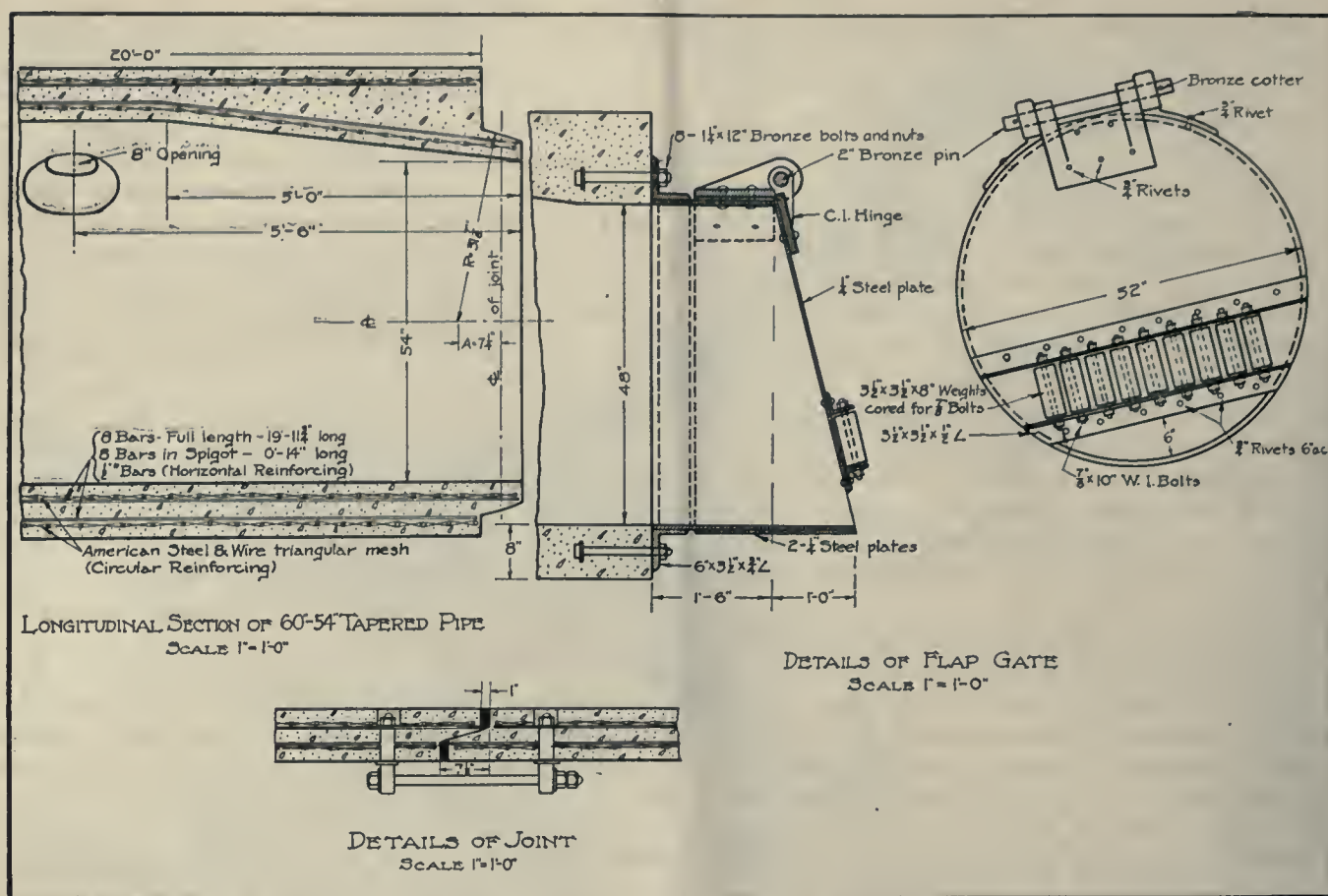


Fig. 3—Details of Concrete Outfall Pipe.

length of submerged steel pipe can usually be laid in a shorter time. This is due not only to the extra number of joints which must be made below water, but also to the amount of time required for hauling the sections to the site of the work.

Allowable Leakage for Submerged Outfalls

It is to be appreciated that absolute water-tightness in a submerged sewer outfall is not so necessary as in the case of pipe lines used for other purposes such as submerged water-supply intakes or land sections of water or sewer pipe lines. However, in order that the general intent of preventing sewage solids from being stranded upon the bathing beaches and of obtaining a continuous pipe line of reasonable tightness may be carried out, it is usually customary to include in the specifications, an item which states the maximum allowable leakage. This amount, of course, varies with the material used, the method of laying and the type of joint and is ordinarily expressed in cubic feet per minute per joint when the entire pipe line is tested under a specified static head. The leakage in the 400 feet of 72-inch concrete and 2,200 feet of 60-inch steel pipe installed at the West 58th Street outlet, as actually measured under test, amounted to practically one-quarter of a cubic foot per minute per joint when the line was subjected to a 6-foot head. The leakage in the 84-inch concrete pipe installed at the East 140th Street outlet, amounted under similar conditions, to approxi-

mately one (1) cubic foot per minute per joint. As soon as the construction of the approach channels leading to the outfall pipe were completed and the last section of 84-inch pipe, containing a tight timber bulkhead, was laid, the flow of sewage was utilized to build up the static head on the pipe line. The quantity of sewage entering the approach channels was regulated and measured so that, for any given head, the total leakage was known. In order to cause a leakage of one (1) cubic foot per minute when tested under six (6) feet of head, a single opening of only about one-half inch in diameter would be required. As mentioned above, while this leakage might prove excessive under certain conditions, yet it is believed that this amount, if evenly distributed along the entire length and not confined to a certain few joints of a submerged sewer outfall, will not be objectionable and may be obtained under average working conditions, with either steel or concrete pipe. The experience in Cleveland demonstrates that submarine pipe joints can be made sufficiently tight without the use of cast-iron flanges.

Type of Outlet at Point of Discharge

Since thorough dispersion of the sewage is to be desired in order to obtain the full benefits of the diluting water, considerable study has been given to the most practical manner in which this result could be obtained. From studies of the various Cleveland installations it is evident that the multi-

ple outlet has a decided advantage, especially in relatively shallow depths. The exact location of the single point of discharge of the Easterly steel pipe line is easily determined since the disturbance on the water's surface is so marked that when the lake is calm, the boiling effect can be seen from shore. In the case of the multiple outlet section, however, it is practically impossible to note any disturbance of the water's surface even from a boat near the outlet. The taper of the pipe is so designed that maximum use is always made of the port-holes along the tapered section. Under maximum flow conditions, the flap gate at the end of the tapered section is forced open and then receives its share of the total flow. Assuming that conditions of operation are the same as calculated in the design and that each opening receives its proportion of the total flow, the discharge from each port-hole (under an average total flow of 75 M. g. d.) amounts to approximately 0.5 M. g. d. This rate of flow from points some 30 feet below the lake level is not noticeable at the water's surface and such an arrangement must obviously result in more effective dispersion than would be the case if the entire quantity of sewage were discharged at a single point.

Conditions Observed About Various Submerged Outlets

The first observations of conditions about the outlets were made in 1913 after the 63-inch steel pipe at the Easterly site had been in operation about one year. Soundings around this outlet indicated that a carpet of sludge had formed upon the lake bottom to a maximum depth of about two (2) feet and that this deposit was fairly well distributed over an area within a radius of from 100 feet to 300 feet from the point of discharge. After the multiple outlet pipe at the Westerly site had been in operation only a few days dredgings were made in its vicinity by dragging a conical iron scoop along the lake bottom, but no evidence of a deposit of sludge was obtained. Six months later, however, masses of sludge varying in size from a few inches to some thirty (30) or forty (40) feet in diameter were seen to rise to the surface of the water in the vicinity of this outlet. These masses disintegrated readily on coming to the surface and either settled again as soon as the gas was liberated or else were scattered in fine particles throughout the lake water. Similar conditions have since been observed about the steel pipe outlet at East 140th Street. Dredgings have shown the presence of a carpet of sludge extending as far as one-quarter of a mile from the point of discharge. This condition was particularly noticeable during the excavation of the trench for the concrete pipe which paralleled the former pipe line and was distant from it about 150 feet. Large masses of sludge were removed by the clam-shell or



Figure 4.

rose to the surface as adjacent layers were disturbed. The material itself is a black foul mass frequently containing large quantities of long thread-like worms. It has the characteristic odor of decomposing sludge and is usually filled with minute bubbles of gas. It has been observed that most of the gas-lifted sludge may be found after a comparatively long period of warm weather during which time the lake has been very calm. As a rule after heavy storms very little of the material will be noticed in the vicinity of the outlets.

While particles of solid matter from sewage, such as matches, hulls of grain, vegetables, seeds and pieces of soap have been found scattered along the shore of the lake for a distance of perhaps two (2) miles from the Easterly outlet, this condition has usually occurred during or just after high sewage flows when the excess storm water has been discharged directly upon the beach. The degree to which this condition will obtain, now that provision has been made to discharge the excess flows 600 feet off shore, is a matter for continued observation. There is no doubt, however, that, under certain conditions, particles from the sewage discharged at the outlets, do find their way to the shore. Floating material recognizable as of sewage origin may be noticed in the water about either outlet, the quantity gradually diminishing with increasing distance from the outlet but being readily visible for a distance of from one (1) to two (2) miles. After prevailing westerly or northwesterly winds such particles have been observed at Euclid Beach, a distance of approximately one and one-half (1 1-2) miles from the Easterly outlet. Seagulls have also been seen taking food from the water as far distant as this point. The same conditions obtain in respect to Edgewater Beach at the Westerly site but to a lesser degree on account of the direction of the natural lake currents and of the prevailing winds.

The discoloration of the lake water about the Easterly steel outlet can, on a clear day, be easily seen from shore and usually occupies an area about

(Continued on page VIII)

A BRIEF DESCRIPTION OF THE CALIFORNIA HIGHWAYS

A General Description—The Organization of the State Highway Commission—The Routes of the State Highway—Standards Set Up in 1912—Types of Road—Specifications Used.

By WILLIAM F. FAUSTMAN, C. E. '07

General

In 1910 the State of California adopted the State Highways Act which provided \$18,000,000 in bonds for constructing a system of state highways.

A second issue of \$15,000,000 was voted in 1916, and a third issue of \$10,000,000 was voted in 1919. The first two issues have been expended in constructing a comprehensive system of roads running generally in a northerly and southerly direction from the Oregon line to Mexico, embracing two routes, one along the coast, and the other traversing the vast inland valleys. The third bond issue provides for completing any gaps left in the two main routes, and for constructing a large number of laterals running crosswise over the State.

It can be said without fear of contradiction that California has one of the most complete and up-to-date highway systems in the country. The highway program is far from complete as yet, but it is the opinion of all who have had the pleasure of riding over its smooth concrete roads, that its highway system is comparable with its magnificent climate and wonderful scenery. Some of the highways run for many miles along the shores of the Pacific Ocean, other roads traverse the ridges of the mountains, or dip down into deep canyons and valleys, and still others encircle beautiful lakes as at Lake Tahoe, a lake that compares favorably with anything Switzerland has to offer. A few hours' ride over state roads takes one from the warm sunny interior valleys to the cool crisp mountain country, with its snow-capped peaks. In August the writer took a trip from his home in Sacramento, where the temperature was around 98°, and spent the night at Lake Tahoe with a highway construction camp. During the night a heavy thunder storm came up, and hail and snow fell, all the mountain peaks around the lake being beautifully white in the morning.

California abounds in wonderful natural scenery, much of which can be reached over its State Highways. The Yosemite Valley and the giant redwoods are samples of what can be found here. Construction work in the mountains is, of course, limited to the summer season, but work in the valleys and along the coast proceeds during almost the entire year, in marked contrast with construction work in the East, where work is shut down during winter months.

California has no so-called state-aid system, under which roads are built for counties or towns, part of the expense thereof being borne by the county or

town, and part by the state. Under the present system in use here, the state bears the entire original cost of state highways within the county, and maintains same. The counties as a rule have furnished deeds to necessary rights of way. Under the present highway law the counties are required to pay the interest on the cost of roads constructed within their limits. This has worked a hardship on some of the counties, and it is proposed to amend this part of the law, so that interest charges will be paid by the entire state.

Construction work has recently been at a low ebb due to abnormal conditions of the financial market, which gave no sale for bonds carrying only 4½% interest, and to the high cost of materials and labor. Few contracts have been let during the past year, and only in cases in which the counties affected by certain pieces of roads within their boundaries, purchased the necessary bonds, have contracts been let. There has been under way a certain amount of work let under previous contracts, a small amount of day labor or force account work, and a considerable amount of maintenance work.

A number of improvements in methods of construction and in equipment used have been developed during the construction of California highways, notably the use of the nail template, which is now employed wherever concrete is laid. This template has projecting nails on its under side, and is dragged along the header boards in front of the mixer. As the subgrade must be sufficiently low so as to be marked by the nails, the danger of pavement being constructed which is thinner than required by specifications is avoided.

Also the ponding method of curing concrete, by covering the newly laid pavement with water held in by check dams or dykes, is a distinct California development.

Also the mechanical tamper, which is run by a gasoline engine and strikes off and tamps the concrete in place, was first employed, it is believed, on California State highways, and these machines are now manufactured commercially in California and in Eastern states.

Also the Osborne Adhesive Machine, an apparatus designed by C. B. Osborne, formerly geologist for the Commission, used for determining the adhesive property or stickiness of road oils.

Organization

The State Highway Commission consists of three members appointed by the Governor. The Highway

Engineer, Austin B. Fletcher, the Secretary and the Attorney, are also the Governor's appointees.

Active work was started January 1st, 1912, at which time the commission established seven division offices in different parts of the state, Division I at Willits, in charge of F. B. Somner, Division Engineer; Division II, at Dunsmuir, T. A. Bedford, Division Engineer; Division III at Sacramento, G. R. Winslow, Division Engineer; Division IV at San Francisco, W. L. Clarke, Division Engineer; Division V at San Luis Obispo, L. S. Gibson, Division Engineer; Division VI at Fresno, J. B. Woodson, Division Engineer; and Division VII at Los Angeles, W. W. Patch, Division Engineer. The Headquarters of the Commission are at Sacramento, where the following branches of the organization are located: The Highway Engineer, who has directly under him six assistant highway engineers, each in charge of a subdivision of work such as bridges, construction work (contract and force account) maintenance work, equipment, and two general inspectors. The headquarters office has general supervision over the entire state, and employs engineers, draftsmen and computers to check over all plans and estimates made by the several division engineers. Here are located also the legal, accounting, disbursing and purchasing departments, each with its corps of assistants. The testing laboratory in charge of a testing engineer and assistants is also located here. The bridge department is in charge of the bridge engineer, with several engineers and draftsmen under him. This department makes original designs for bridges on the state highways, when necessary, and also checks designs made by county engineers. The state generally has an inspector present on all county bridge construction.

The seven division offices are each in charge of a division engineer, who has under him two or more assistant engineers, and a staff of resident engineers, office engineers and draftsmen, surveying crews, superintendents, and foremen on day labor and maintenance work, with necessary clerical force.

Routes

The state highways are designated by county, route and section, as "Sac. 3-B," meaning this road is located in Sacramento County, on Route No. 3, Section B. The main routes of the state highway system run from north to south, routes 1, 5 and 7 being part of the main coast route, and routes 2, 3, 4, and 6 parts of the main interior or valley route. Other routes from No. 8 up embrace a number of cross-routes or laterals. A county may have a number of sections lettered A, B, C, etc., generally ten miles in length, more or less. All lettering and stationing of sections on main routes begins at the southerly boundary line of a county, and extends in a northerly direction.

Standards

In 1912, at the beginning of its work the commission set up certain standards or principles to be followed in its state highway work. Briefly stated these were:

1. A readjustment of the road locations or rights of way so as to secure proper alignment and to obviate the necessity of traveling around section corners.

2. Rights of way of uniform width, preferably not less than 60 feet wide.

3. Maximum gradients in the mountainous country of 7 per cent and minimum radii on the center lines of such roads of 50 feet, with all curves opened out as much as possible by flattening slopes and removing brush and such trees as interfere with the view. A clear sight of at least 150 feet should be secured wherever it is practicable.

4. The construction of permanent culverts, gutters and ditches wherever they are needed to prevent water from standing on the roadsides and on grades to prevent gulying due to the water being carried too far in the gutter and thus accumulating in volume.

5. The construction of bridges of a permanent character, preferably of reinforced concrete, such bridges to be at least 21 feet wide in the clear and so designed that they will carry 16-ton traction engines with a reasonable factor of safety.

6. A minimum width of roadway of 16 feet, which may be traveled safely, such width to apply only to those places in the mountains where there is so much rock as to make a greater width prohibitive on account of its cost. An average width throughout the remainder of the state of 24 feet on embankments, of 21 feet in through cuts, and 22½ feet where the road is part cut and part fill.

7. A crown or cross-camber varying from one inch to the foot where no surfacing is applied to less than three-eighths of an inch where bituminous surfaces are used, in all cases the crown to be the least needed to cause the water to run quickly from the road into the gutters.

8. Such type of surfacing as the needs of the locality require varying from the graded road to the highest type of asphalt paving and varying in width from 15 feet to 24 feet.

9. The erection of guardrails at dangerous points on grades and on high embankments.

10. The proper trimming of slopes along the roadsides, both old and new, so as to prevent the unsightly gashes now so noticeable along the roads. Also, the planting of suitable trees, indigenous to the locality, and properly caring for them.

11. The placing of proper permanent monuments at the time of construction along the roads to mark accurately the limits of the right of way. Also, the erection and maintenance of guideboards marked to show places and distances accurately.

Types

Approximately 1,250 miles of concrete base with or without thin bituminous tops, 60 miles of concrete or broken stone base with Topeka or asphalt tops, 200 miles of oiled macadam, and 1,200 miles of graded earth roads, a total of about 2,700 miles, have been built.

The principal type of road constructed by the State Highway Commission is the concrete base with a thin bituminous carpet of asphaltic oil and stone screenings. This section of road has averaged about fifteen feet wide and four inches thick, on country roads, being thicker and wider near the populous centers of the state. The usual concrete mix is 1:2:4. No expansion joints are in general use, nor has reinforcement of the base been necessary except in cases of unusual soil conditions. The increasing use of motor trucks with their heavy loads is bringing to the front in this state as in other states, both the question of a stronger base and the question of more stringent laws regulating the use of motor trucks on state roads. It is practically a certainty that a stronger concrete base will be used in future in this state.

Specifications

Following is a brief description of the specifications used:

Grading—All stumps and vegetation within the roadbed and slopes are removed, and soft spots are filled in with good earth or gravel. Embankments are made of suitable material spread in layers not over one foot thick. The entire width is watered and rolled until the surface is smooth and hard.

Concrete Materials—All cement must meet the specifications of the A. S. T. M. It is purchased in large quantities and a tested stock is left at the different mills to be drawn on as needed for the work.

The sand used in concrete construction is tested for strength in compression and tension in a 1:3 mortar, and must show a strength equal to that shown by the standard Ottawa sand mortar.

Placing the Concrete—2x4-inch planks are placed on edge and securely nailed to inside of stakes on each edge of pavement. For a thicker base, 2x6 inch planks are used. The tamping template rides on the headers, and great care is used that the headers are true to line and grade, so as to produce a smooth, even surface of concrete. The subgrade is checked by the use of a template with spikes set true to the crown of the roadway.

The concrete base is laid on a damp subgrade. It is tamped with heavy crown grade tampers resting on the header boards. A canvas belt is then used to smooth up the surface, and it is finished off with wooden floats. Great care is used to have just the right amount of water used in mixing concrete. The materials must be mixed in a machine for at least one minute, the maximum speed of the drum

not exceeding sixteen revolutions per minute. The concrete is kept damp by sprinkling for 24 hours, and then cured under water for ten days. The road is checked by low earth dams into shallow ponds 12 or 15 feet square. The pavement is opened to traffic one month after laying.

Expansion joints are omitted except at the end of a day or half-day run of concrete. As all concrete bases are intended to be covered with some kind of an asphaltic top, the inevitable lateral cracks, with or without expansion joints, give little trouble. The coarse aggregate is sound gravel or clean broken stone graded in size from $\frac{1}{4}$ to $2\frac{1}{2}$ inches. The abrasion test is made on rock. Samples must show a minimum coefficient of wear of 9.

The concrete is now mixed in proportion of 1:2:4, a compressive strength of at least 2,000 pounds at 28 days is required of this mixture. Before the concrete is laid, the subgrade must have the same crown as the pavement. In the past, reinforcement has been placed only over adobe soils which tend to develop long longitudinal cracks, but it is now being placed in all pavements.

This reinforcement consists of 3-8-inch square rods, placed 18 inches on centers transversely, and one rod along each side of pavement.

Culverts—For drainage purposes, corrugated metal pipe are placed transversely on the road, from 12 to 24 inches in diameter, for small openings; for larger openings, reinforced concrete culverts are used, either with or without bottoms. Concrete headwalls are built on all culverts.

Guard Rail—The typical wooden guard rail in use consists of 6x6-inch Redwood posts, six feet long, set 2.5 feet into the ground, with two 2x6-inch Oregon pine rails, all painted white.

Monuments—Concrete monuments are set at curve points, etc., being 6x6 inches by 3 feet 6 inches in size, set at least 3 feet into the ground.

Superelevation—In the valleys and on moderate grades the Commission has not done much along this line of superelevation. The maximum speed allowed by the motor vehicle law in open country is 35 miles per hour, where the view ahead is unobstructed. It is a very difficult matter to rigidly enforce speed laws, and it may become necessary to superelevate roads on all curves of less than about 300 feet radius. On the mountain roads this is more urgent, and to meet these conditions the following rates of slope for superelevations have been suggested:

For radius of 75 feet or less, 3-4 inch per foot.

For radius of 100 feet to 150 feet, 3-8 inch per foot.

For radius of 225 feet to 300 feet, 1-8 inch per foot.

The transition between curved sections and tangent sections will ordinarily be made in a length of 30 feet.

Oiled Surface—The so-called California carpet or bituminous surface is placed on the concrete base at

any time after the pavement is laid, by applying two layers of asphaltic road oil and screenings to a thickness of about $\frac{1}{2}$ inch. This surface coat is readily applied, and costs about 15 cents per square yard, having a life of about five years. It is readily repaired, and has proved a very satisfactory surfacing. The oil used is what is known as "E" grade asphalt, obtained from California oil fields, having a penetration of about 125°. The oil is applied at a temperature of about 350° F., preferably during warm weather, at the rate of about 0.6 gallon per square yard of surface.

Bridges—The following rules governing the design of bridges have been adopted by the Commission, with possibly some subsequent modifications:

a. All structures are to be designed by competent engineers, and the plans, specifications and workmanship are to be subject to the inspection and approval of the Highway Engineer.

b. The width of such structures shall be not less than 21 feet in the clear.

c. Concrete bridges are to be designed to sustain, in addition to the dead load, a uniform live load of 150 pounds per square foot of roadway, and the floor system to carry a 20-ton traction engine.

d. Steel bridges of span less than 150 feet shall be designed to sustain, in addition to the dead load, a uniform live load of 100 pounds per square foot, and the floor system a 15-ton road roller; for spans in excess of 150 feet, a uniform live load of 85 pounds per square foot, the floor system to carry a 15-ton roller.

e. Trestles shall be designed to sustain, in addition to the dead load, a uniform live load of 150 pounds per square foot of roadway, and the floor system a 15-ton road roller.

The Commission is in favor of concrete bridges wherever possible. A large number of notable structures have been designed and built by the Commission, among them the following: Reinforced concrete trestle over the Yolo By-Pass, more than three miles in length, costing about \$500,000; a reinforced concrete arch span, 242 feet long, over the Pit River, Shasta County; several bascule bridges, and a large number of different kinds of concrete, steel and timber bridges, the latter kind only in the mountain regions, where it is difficult to obtain concrete and steel materials.

Standard designs and plans have been made for concrete bridges of various types and spans, the prevailing type being the short span reinforced concrete girder bridge.

Testing Laboratory—California has a very efficient Testing Laboratory, and a brief description of its work follows.

In this department are tested samples of all materials proposed for use in highway construction. Reconnaissance surveys have been made of the un-

developed sections of the State, to ascertain the location of suitable deposits of rock, sand and gravel, and samples have been taken and tested in the laboratory. In the more developed sections, the material companies' plants are visited, samples taken for tests, reports made on their equipment and available supplies, possible output and shipping facilities.

The testing laboratory also makes tests of sections of finished highway. A Calyx core drilling machine has been mounted on a light motor truck, which moves to different parts of the State, taking samples of pavement. A $4\frac{1}{2}$ -inch cylinder is cut out of the pavement by the use of chilled steel shot. The drilling power is furnished by a 3-HP gasoline engine. The average concrete pavement can be drilled in 10 or 15 minutes. The test pieces are in good condition for compressive tests, these showing that concrete pavement 3 to 4 years old has a compressive strength of over 3,000 pounds per square inch. The borings taken from the pavement are also valuable for furnishing an exact record of the thickness of base, and in showing just how thoroughly the concrete was mixed at the time of laying. The U. S. Office of Good Roads is at present making an exhaustive investigation of the highways in this State, and is using this Calyx core drilling machine in their work.

Tests are made in the laboratory, of cement, sand, gravel, rock, asphaltic oil, concrete, asphalt, etc. All tests are made according to the methods of the American Society of Testing Materials. Samples are taken during the construction of all pavement or surfacing work, and in this way close watch is kept on all mixtures, particularly of asphalt and Topeka mixtures.

The asphaltic oil used on California roads is a by-product of the California oil refineries. It contains about 90% of asphalt of 80° penetration for "D" grade, and a higher penetration for "E" grade, about 125°. The two most important physical properties of road oil, to the road builder, are viscosity and adhesive strength. To test the latter property, the Osborne adhesive test apparatus has been designed and used. In principle this device is a journal lubricated with the oil under test, and operated by a constant pull of a given weight, causing the outer cylinder to revolve. The time required to complete three revolutions of this cylinder is taken as the measure of the adhesiveness of the oil. A constant given temperature of 77° F. is maintained by means of water flowing through the fixed cylinder or axle. It has been found that oils which require 300 seconds for the adhesive test will bind the bituminous surface tightly to the concrete base and cement together the pieces of crushed rock screenings that make up the mineral aggregate of the wearing surface.

Oils that have a viscosity of less than 100 (Engler

test) are oils that can be applied under pressure of a spray at a temperature of from 250 to 350° F., and such oils when applied are not "hard." They will readily incorporate the covering of stone screenings and build up a wearing surface of proper thickness.

The bituminous surface is dull black in color, has been found to be "alive" and sticky after years of traffic, and mends itself rapidly when cut by traectors or in other ways. It does not roll or become wavy as oiled macadam often does, and gives good traction to traffic, as well as being easy on horses' feet.

The analysis of samples of this asphaltic wearing surface after a few years of traffic shows it to contain about 9-12% asphalt, and the mineral aggregate conforms to a stone filled sheet asphalt, i. e., a sheet asphalt containing about 10-30% aggregate retained on a 10-mesh sieve and passing a 1/2-inch sieve.

Materials—The State has up to this time furnished all materials of construction to the contractor, such as crushed rock, sand, cement, steel, culvert pipe, etc., the contractor being required to furnish the labor and other items necessary in the construction of the road. The Commission has had the advantage of being able to purchase materials in large quantities at a very low figure, to the great benefit of the public and the work itself, as only first class materials were purchased. It has also had the benefit of an extremely low freight rate, being 1/2 cent per ton average on rock. The contractor has had no excuse for cutting down on his cement or for substituting a poor grade of material, with the result that a high grade of work has been done. The uncertain state of the market today, as well as the changing freight rates, etc., make it possible that there will be a change in the policy of the Commission regarding the furnishing of materials to contractors, in future.

The cost of materials entering into highway construction today is as follows:

Crushed rock, \$1.00 per ton f.o.b. plant;

Sand, \$.75 per ton f.o.b. plant;

Cement, \$2.70 per bbl. f.o.b. plant;

"E" grade asphalt, \$19.00 per ton f.o.b. plant;

Reinforcing steel, \$120.00 per ton, f.o.b. San Francisco.

To show the great advance in the cost of materials, rock formerly cost \$0.45 per ton, sand \$0.25 per ton, cement \$1.45 per ton, asphalt \$12.50 per ton, and steel \$40.00 per ton. Freight rates have more than doubled.

Labor—Labor has advanced in proportion. Common labor was formerly \$2.50 per day, now it is \$5.00. The same ratio holds for skilled labor.

A concrete road which formerly cost \$10,000 per mile now costs about \$25,000. A shortage of freight cars also increases the cost of construction at pres-

ent. The following figures show the cost of the two main items of construction, grading and concrete, for labor, during the past five years, and shows the advance in cost in 1920 over 1916, before the war affected highway work seriously:

| Year | Grading | Concrete |
|------|------------------|------------------|
| | Cost per Cu. Yd. | Cost per Cu. Yd. |
| 1916 | \$0.49 | \$2.92 |
| 1917 | .73 | 4.17 |
| 1918 | .78 | 5.53 |
| 1919 | .98 | 6.48 |
| 1920 | 1.19 | 7.70 |

Maintenance—The Motor Vehicle Act of 1913 provided that one-half of the funds derived from the registration of motor vehicles should be available for maintaining the state highways. The writer is familiar with conditions in Division III, where he has been in close touch with maintenance work for several years. A force of about thirty superintendents and foremen, with a large number of truck-drivers and laborers, is steadily employed on maintenance work, which varies from the ordinary patrolling or maintenance work and repairs to the construction of several miles of road, as in the case of a county road taken over by the State and rebuilt.

There are in Division III alone seven maintenance yards or stations, at each of which are located an oil heating plant for heating asphaltic oil for patching and oiling concrete pavement; also there is a large maintenance yard and shop at Sacramento. At this latter point the large stores of equipment and parts turned over to the State by the Federal Government after the recent war, are received, stored, repaired and shipped to various points in the State. Hundreds of automobiles, trucks, wagons, and all kinds of road equipment have been received from the U. S. Government for use on State work, and some equipment has been turned over to the counties also.

Over \$2,000,000 has been expended for maintenance of roads during the past year in this State, on specific maintenance, general maintenance, and repair and upkeep of maintenance equipment.

In the mountain districts the earth roads predominate, and maintenance work consists of dragging and grading, sprinkling during the summer months for the heavy travel of this season of the year, widening of curves, gravelling bad spots, improving drainage, etc. Some of our earth roads are as smooth and easy riding as a concrete pavement.

Convict Labor—Convict labor has been given a tryout in this State, with some success, and several stretches of mountain roads have been constructed by convict labor. The men are usually honor men, who prefer work in the open to confinement within prison walls. A few escapes have been made, but as a rule not much trouble has been experienced from this source. The prisoners are paid \$0.50 per day

(Continued on page VII)

STATISTICAL ANALYSIS OF THE CENTRAL ELECTRIC STATION INDUSTRY OF CANADA

From Dominion Water Power Branch of the Department of the Interior.

Electrical energy, through its ease of transmission and its broad adaptability to domestic, industrial and commercial use, has become of paramount importance to our modern life. The generation of electricity, dependent in the greater part upon coal and water power, has offered outstanding advantages to the efficient utilization of the latter and Canada has been quick to appreciate the peculiar advantages possessed by her strategically located water powers and to realize in their development for hydro-electrical purposes, one of her greatest natural resources. In this development the central electric station industry has played a most important part and in view of its exceptionally rapid development, particularly during recent years, a record of its present standing is of special interest.

The Dominion Water Power Branch, Department of the Interior, in co-operation with the Dominion Bureau of Statistics is publishing an analysis of the results of the second census of central electric stations in Canada, showing the status of this important industry at January 1, 1920. The report includes statistics relative to central electric stations only, as defined for census purposes, i. e., stations which sell or distribute electrical energy for lighting, heating or general power purposes, other than that generated by industrial organizations for their own direct use in the operation of some other industry. The statistics, therefore, treat only with the generation and distribution of electrical energy insofar as such energy is not used directly by the station reporting. In each case where the central electric station operations are combined with those of some other industry, special care was taken to secure statistics relating only to that of the operations which are chargeable solely to the central station activities.

The central electric stations are divided into two fundamental classes, generating stations which include stations generating all or part of the power they sell or distribute, and non-generating stations which purchase from some other station all the energy they sell or distribute. The analysis further divides the stations according to ownership and type of power used, into the following classes; municipal, and commercial, hydro-electric power, and fuel power stations. The statistics are given for the Dominion as a whole and by provinces. As the analysis has just been completed and some time must necessarily elapse before the report is ready for general distribution the following brief summary of the statistics has been prepared.

The principal items reported, together with a

comparison between the totals for commercial or privately owned and municipal or publicly owned stations, are summarized as follows. The total number of stations reporting is 795, of which 515 or 64.8 per cent generate their own power and 280 or 35.2 per cent are of the non-generating type. The commercial stations numbered 377, and the municipal stations 418. Of the generating stations 332 are commercial and 183 municipal, while of the non-generating stations 45 are commercial and 235 municipal. As noted in the results of the last census the system of the Hydro-electric Power Commission of Ontario with its extensive distribution, selling blocks of power to local municipal commissions, accounts for a large proportion of the municipal non-generating stations.

Primary Power Equipment

The aggregate capacity of all primary power machines reported, is 1,958,642 horse power, of which 1,841,114 horse power is installed in main plants and 117,528 horse power in auxiliary or stand-by plants. Of the total for the main plants 1,434,196 horse power or 77.9 per cent was reported by commercial stations, and 406,918 horse power or 22.1 per cent by municipal stations while of the auxiliary plant equipment the former accounted for 110,853 horse power and the latter 6,675 horse power. According to source of power the total for all prime movers is divided as follows: from water 1,682,191 horse power, from steam 262,562 horse power, and from gas and fuel oil 13,889 horse power.

Power Equipment Per Capita

The per capita analysis is given by provinces as this is the only feasible basis upon which such a comparison may be made in connection with the central electric station industry. Consideration of other elements such as the varying density and the occupation of the population will assist in a better understanding of the variations in the per capita development. The average primary power installation of the main plants per thousand population for the Dominion is 209 horse power.

The provincial averages on this basis are as follows: Yukon 1,135 horse power, per thousand population, British Columbia 302 horse power, Ontario 277 horse power, Quebec 263 horse power, Alberta 129 horse power, Manitoba 121 horse power, New Brunswick 50 horse power, Saskatchewan 41 horse power, Nova Scotia 38 horse power and Prince Edward Island 14 horse power. It is notable that the highest averages on the per capita basis occur in the Yukon Territory and the five provinces in which the

greater proportion of the central electric station power is derived from water.

Hydro Power in Central Electric Station Industry

The extent of Canada's water power resources, their availability to industrial centers and their adaptability to the central electric station industry is reflected to a marked degree in the statistics presented in this report. Hydro-electric power is now served to practically every large industrial centre in Canada and the rapid extension of the large distribution systems together with the active hydro-electric construction at present in progress is fast linking up the few centres which have hitherto derived their power from fuel. In considering the extent to which water is used as a source of primary power in this industry it is of interest to note that according to a recent census of developed water power in the Dominion 72.7 per cent of the total is utilized in connection with the central electric station industry.

Of the aggregate capacity of all prime movers installed in the main plants 1,682,191 horse power or 91.4 per cent is derived from water, and including the prime movers of auxiliary or stand-by fuel plants the hydraulic installation represents 85.0 per cent of the total. The percentage of hydro-electric power in the various provinces is as follows: Quebec 98.4 per cent, Yukon Territory 97.8 per cent, British Columbia 97.2 per cent, Manitoba 95.5 per cent, Ontario 95.4 per cent, Alberta 42.9 per cent, New Brunswick 37.6 per cent, Nova Scotia 18.5 per cent and Prince Edward Island 16.8 per cent. Saskatchewan derives 100 per cent of its central electric station energy from fuel. From this it will be seen that the first four provinces named and the Yukon Territory reported over 95 per cent of their total central electric station power derived from water. With the completion of projected hydro-electric developments in Nova Scotia and New Brunswick the hydro-power percentages for these provinces will show a marked increase.

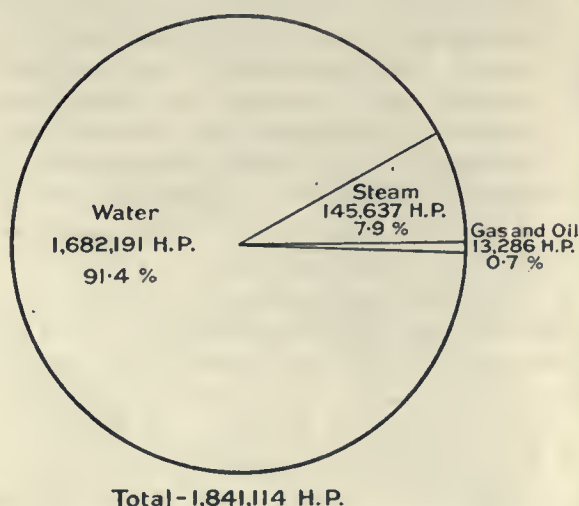


FIG. 1. Central Electric Stations.—Primary Power by character of Power not including the 117,528 h.p. installed in auxiliary fuel plants 1918.

In Ontario, Quebec, British Columbia and Manitoba the steam plants, which are auxiliary to hydro-developments, account for 113,350 horse power or 69.2 per cent of the total steam power installation for these provinces. It should also be noted that for the Dominion as a whole there is installed in connection with hydro-electric developments 117,198 horse power in auxiliary fuel plants.

The results of the analysis of the primary power equipment are presented graphically in the accompanying diagram (See Figure 1) which illustrates the comparative importance of each of the three principle sources of primary power in the central-electric station industry in Canada.

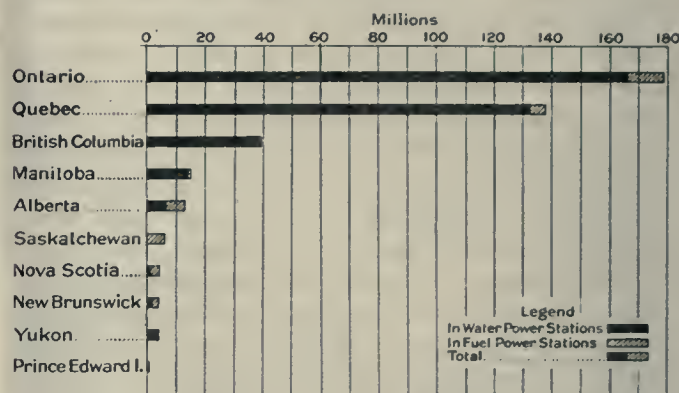


FIG. 2. Central Electric Stations.—Capital Invested by Provinces, 1918

Employees, Salaries and Wages

The total number of persons reported as employed in the central electric station industry in Canada is 9,696 with salaries and wages aggregating \$10,354,242. Commercial stations employed 5,690 persons at \$6,137,525 and municipal stations 4,006 persons at \$4,216,717. The total number of persons employed in the industry averages 5.2 per thousand installed primary horse power, while the aggregate salaries give an average of \$5.62 per installed primary horse power. In connection with the statistics of employees' salaries and wages, it should be noted that in a considerable number of cases employees are engaged for only part of the time in connection with the central electric station operations, the balance of their time being charged to some other work not connected with this industry. This is particularly the case in non-generating municipal stations and in composite stations where the sale of electrical energy is only incidental to some other industrial activity. In instances of this kind only that part of the salaries or wages properly chargeable to the central station industry is recorded.

Financial Statistics

A summary of the financial statistics for the Dominion shows that the total capital invested in the industry was reported as \$401,942,402 of which \$356,547,217 represents the investment in power development and transmission and distribution systems and \$45,395,186 represents miscellaneous sup-

(Continued on page IX)

REPORT OF THE CHIEF ENGINEER

The Organization, Various Branches Covered, Camp Notes.

C. E. CAMP, OF CLASS OF 1922
F. W. LAKE, '22

In accordance with the usual custom of the Civil Engineering College and Forestry School, the class of 1922 spent the five weeks immediately following the close of the second term of the sophomore year in surveying a tract of land on the west shore of Cayuga Lake approximately twenty-five miles north of the city of Ithaca. The camp was located on Fred Ditmar's farm at Elm Beach, on a bluff overlooking the lake and thus excellent drainage was assured. The camp site was fine for all purposes except that it was not centrally located, and was too far south for the parties whose plots occupied the northern section of the tract to be surveyed.

The object of these summer surveys of the college is to give the students practical knowledge in the various branches of surveying and at the same time to eventually produce a map of Cayuga Lake and the surrounding country. The area which was surveyed by this camp extended from the northern limit of the 1919 survey, a half mile north of Shel-drake Point, about five miles north along the lake; and about three miles west from the lake, or about fifteen square miles in all.

Before going to camp, permanent topography parties were made up as follows: twelve C. E. captains who were taking the full five weeks' course, four C. E. captains who were taking the three weeks' course, and two Forestry captains who were taking the full forestry course of six weeks. These men were appointed by the faculty of the college. The regular five weeks' parties consisted of four or five men each and the captain, while the three weeks' parties consisted of three men each and the captain. In each of the Forestry parties was a landscape art student who was required to spend only two weeks in the camp. Beside the permanent topography sections there were several special students who were making up work they had missed in previous camps. For the first three weeks there were from 98 to 101 men at camp, and during the remainder of the camp there were from 77 to 80 men in attendance. Each of the regular topography parties was assigned a plot approximately a mile square, while the parties consisting of men taking the short course were assigned a plot of about one-half square miles. The assignment to plots was made by lottery. A map of the area to be covered by the survey was made before camp opened, showing the plots, plot corners, roads, railroads, towns, streams, and many of the buildings. Blue prints were made of this map and each of the topography parties was furnished with one.

Under the direction of Professor Lawrence the

camp site was cleared and the kitchen tent erected a few days before the opening of the camp to the students.

On the morning of June 14 those students who were going to attend camp met at the foot of Buffalo Street, where the Utowanna and the Horton were waiting with the baggage to take the men to camp. The two boats docked at the camp about noon, and the rest of the day was spent in erecting the tents and arranging personal property. Tuesday was spent in putting up the computing tents, assorting and numbering the instruments, and installing a pipe-line from the spring to the kitchen tent. During this first week very little work was done on the actual survey, due to constant rain. On Saturday morning, as it looked like rain, the men left for town to see the Intercollegiate Crew Races, and so the first real start of the survey began on the following Monday.

The C. E. students of the short course were regularly assigned to topography, while the four men from each of the other parties were assigned daily to topography and the remaining men were given such special work as the progress of the various branches required. For about the first two weeks the Forestry parties were required to do special surveying work which they had not had during the regular terms at Ithaca. The two landscape art men, together with two of the special students, made a plane table map of the camp site. The special assignments were made so that as nearly as possible each man had: topographic levels, three days; precise levels, two days; hydrography, two days; triangulation, three days; base line, two days; and camp duty, three days. There were very few cases in which the above did not work out as planned.

Topography

It was the duty of each party to make a complete map and tracing of the plot assigned. Professor Weber and Messrs. O'Rourke, Pendleton, and Perry had supervision of this part of the survey.

After the instruments had been adjusted and their stadia constants computed, closed and connected traverses were run, using the stadia method, within and including the boundary lines of the plot. An error of closure of 1:800 was allowed for the first traverse while 1:500 was permissible for the rest of the traverses. The topographic features, including buildings, roads, telegraph lines, woods, streams, etc., were located by stadia side shots, spur stations, or jump stadia traverses. This part of the survey was aided by the use of the plane table, as each party was allowed the use of one for two days.

Plotting was done by means of the regular co-ordinate system, side shots being plotted with the aid of the protractor and scale. The maps were drawn to a scale of 1:4800 and the contour interval was 10 feet.

Each of the plot surveys were tied in to one or more triangulation stations and thus a control of the entire tract surveyed was accomplished. The control of the elevations was effected by including all the plot corners in the regular stadia surveys, the elevations of which were determined by running systems of topographic levels between them.

Base Line

The establishment and measurement of the base line was carried out under the direction of Professor George. It was located on the road running south from Hayt's Corners, and the triangulation stations at its extremities were clearly visible from many of the other stations on both sides of the lake. The great disadvantage, however, was that there were two small angle points on the line which gave some difficulty in computing the corrected length.

The apparatus for producing the required tension in the tape consisted of a metal bar with a pointed end for sticking in the ground, for holding the rear end of the tape, and a similar bar with a lever attachment for keeping constant tension by means of a weight, on the front end. A fifty meter invar tape compared with government standards was used. In laying out the line, "two-by-fours" with zinc strips on the tops were set at the fifty meter points, and supporting stakes were driven at the mid-points. All of these stakes were carefully lined in with a transit, and corrected for elevation by running a system of levels along the top of the stakes. The rear end of the tape was held at a scratch on the zinc strip and when the tension apparatus registered 15 kilograms a similar scratch was made on the zinc strip at the front end. The temperatures of the tape were then recorded. Short spaces at the end of the line were measured with a standard steel tape.

The length of the line was approximately 1,000 meters long. It was measured twenty-five times, twenty-four of which were taken in the final averaging. The greatest difference between any two readings was six tenths of a meter, which gave an accuracy of about 1:400,000. It was customary to measure the base line about four times per day.

The usual base line parties consisted of eight men, a note keeper, front tension, rear tension, front thermometer, rear thermometer, front contact, rear contact, and a man to support the tape at the center while it was being moved forward.

Triangulation

Under the supervision of Professor Conwell the triangulation system was carried on. Several of last year's stations were used as a tie between the two

systems. The total number of stations read upon was sixteen of which six had been used in the survey of the previous year. During practically the whole of camp it was impossible to obtain readings all during the day from any one station due to the heavy mists over the lake and the reflection of the sun. The record number of sets for any one day slightly exceeded thirty, which was an excellent number considering the disadvantages caused by the weather. The average difference between any two sets read on the same angle was about five seconds.

The usual party consisted of two men, one of whom read the angles and the other who took notes. When either of the theodolites was used a three-man party was sent because of the weight of the instruments and the difficulty of transporting them.

Precise Levels

The continuance of the system of precise levels was under the direction of Professor Underwood. The precise level lines of former years were continued along the Lehigh Valley track and two spur lines were run to the lake shore at the northern and southern extremities of the section surveyed along the track. These spur lines served to act as a control of the topographic levels and were checked by the lake levels at the northern and southern extremities of the survey.

Two parties were assigned to this work daily after the first two weeks of camp. Each party consisted of five men whose duties were as follows: an instrument man, two rodmen, a notekeeper, and a man to carry the sunshade for the instrument and to see that it was always kept over the instrument even while it was being moved from one setup to another. As in base line work the organization of the party was changed often enough so that each man was acquainted with the duties of each position. The total length approximated seven miles and each section was leveled at least four times so that a close check could be made.

Topography Levels

Professor George had charge of the topography levels which were run for the purpose of obtaining the elevations of the plot corners as a control of the stadia elevations. The elevations were based on that of the U. S. G. S. bench mark on Lincoln Hall, from which precise levels and lake levels had been run, and from which several bench marks along the northern boundary of last year's survey had been located. The lines were mainly run along the highways, connecting in with all of the plot corners which were used. Separate circuits were closed and adjusted so the accuracy of the entire work was as consistent as possible.

Leveling from the lake surface was also carried on at several points along the shore and these elevations were used as a check on the regular method of

(Continued on page 44)

THE CORNELL CIVIL ENGINEER

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The Association of Civil Engineers of Cornell University, Ithaca, N. Y.

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COLLEGE NOTES

New York State

Endowment Campaign.

Starting with the preliminary organization meeting held on Saturday, October 23 in the dining hall of Prudence Risley the plans and preparations for New York State Cornell Day and for the New York State Endowment Campaign have proceeded so rapidly and so successfully that all indications point toward the success of these two "distinctly Cornellian" occasions.

New York State Cornell Day, which was held in Ithaca on Saturday, November 13, was an innovation which will probably become an annual custom. Eight thousand formal invitations were sent out to the alumni of New York State to be present at the Alumni gathering on Saturday. Fully 5,000 alumni accepted the invitation and attended the first "Fall Spring Day." The program for Cornell Day included a meeting of the alumni at noon, a reception for the alumni given by the University Faculty and Board of Trustees, a buffet lunch in the drill hall, and the Cornell-Columbia football game. It is hoped that Cornell Day will become a permanent annual institution which will serve to increase the interest of the New York State alumni in the University.

The New York State Endowment Campaign was held during the week following Cornell Day, November 13 to 20 and centered on an attempt to reach every Cornell man in the state. Cornell meetings were held in at least 65 cities throughout the state. At each of these meetings some Cornell man, either a member of the faculty or the board of trustees spoke. It was for this worthy cause that Professor L. C. Urquhart, C. E. '09, had been granted leave of absence, as he was appointed to one of the special committees of the New York State Endowment Campaign.

Cornell 60

Union 0.

The Varsity Football Team won its third game Saturday, October 16, defeating Union by the overwhelming score of 60 to 0. The light team of the visitors was helpless before the onrushes of the Cornell line which broke holes in the opponent's line, allowing the backs to get through for big gains. The Cornell team was equally powerful when on the defensive and allowed the Union team to cross into the Cornell territory but once in the entire game. This was in the last quarter after Coach Dobie had put in the entire second team with the exception of one man. Kaw of the backfield starred, and Mayer, also of the backfield, carried the ball for some big gains. The score at the end of the first half was 20 to 0. The good condition of the Cornell team was evidenced by the fact that not one Cornell man was injured during the entire game.

The Cornell-

Colgate Game.

Over ten thousand people saw the Cornell Varsity Football Team defeat the Colgate Team at Ithaca on Saturday, October 23. This is the first victory Cornell has had over Colgate since 1911. The Cornell line continually broke through Colgate's line, and, with the exception of the time when Colgate scored their single touchdown, the Cornell goal was in no danger. Kaw of the Cornell backfield was the star of the game, making four of the six touchdowns for Cornell and many big gains on his end runs. Munns, right end, and Mayer, right halfback, also did good work for Cornell. For Colgate Webster, right halfback, played a good steady game, scoring the only touchdown made by his team. He received the ball from Cornell's kick-off and carried it from his 10-yard line across the Cornell goal line. The score at the end of the first half was 21 to 6, and the final score was 42 to 6.

For once Coach Dobie's prophecy of Cornell's defeat has come true. He stated that he was not surprised at the outcome for he was well aware of Dartmouth's power and was also cognizant of the weaknesses in the Cornell team. This year those weaknesses are being ironed out and Dobie is primarily occupied in building a system. When it is remembered that a great many of the leading players on the present Varsity are only sophomores the outlook for next year is brilliant and there seems to be some justification for the remark which was heard in every section of the stands at the Polo Grounds, "Wait 'til next year."

The Freshmen In a loosely played game the Cornell Freshman team lost its first game on Saturday, October 23, to the Mansfield Normal School team by a score of 7 to 0. Both teams lacked team work and numerous fumbles were made. During the first half the teams were fairly well balanced and it was not until the last quarter that the visitors scored. In the last two minutes of play the Freshman team opened up and with three successful forward passes brought the ball from their 30-yard line to Mansfield's 6-yard line. The game ended with the ball in Cornell's hands and on Mansfield's half-yard line.

The Hallowe'en Rush. The annual Hallowe'en rush between the Underclasses took place as per tradition on Saturday night, October 30. The date of occurrence, however, was the only semblance of tradition that was present. This year the rush was entirely devoid of all the undesirable characteristics that were present at all the previous rushes.

This year the Student Council planned the rush and the C men supervised it. The plans of the Student Council called for a snake dance downtown led by the University Band. The snake dance turned out to be an affair for all classes for on Saturday the Cornell teams won every contest on their schedules and every Cornellian felt the need of a little celebration. After snake dancing for an hour in an orderly manner the band led the way up the Hill to Lower Alumni Field where the freshman and sophomores held a pushball contest—Alumni Field having been especially illuminated with flood lights for the occasion.

Acting President Smith was really responsible for the orderliness of the rush. It was he who suggested to the Student Council that they plan and supervise the rush. It was he who realized that the time had come for the elimination of the undesirable features of the rush. Future Hallowe'en rushes will be held with the same spirit of class hatred and the same intensive struggle for class supremacy that characterized the old rushes, but the destruction of the

property belonging to the citizens of Ithaca and the menace to the lives of innocent bystanders will be gone.

John Hoyle, John Hoyle succeeded Charles E. Courtney, the Dean of Varsity Crew Coach. American Rowing, on Saturday, October 23, 1920, when he was officially appointed Head Crew Coach of the University Crews by the Crew Committee of the Major Sports Council.

Mr. Hoyle, who has been principal assistant to the "Grand Old Man" for the past twenty-one years, first as boat builder and later as Assistant Crew Coach, has had a wonderful opportunity to study and to thoroughly absorb Coach Courtney's methods of training the Varsity Crews. He has made himself an expert on the Courtney stroke and is now the best authority in the country on the stroke which has put fear into the hearts of Cornell's rival eights time and again.

The Varsity Crew Association composed entirely of Alumni who have rowed on the Varsity Crews, has appointed J. S. Collyer '17, as their representative to see that Coach Hoyle follows Courtney's methods. But this move was entirely unnecessary for Coach Hoyle states that he does not intend to depart from the Courtney system which has stood at Cornell for the last thirty years. He believes that the Courtney system will produce as excellent results in the future as it has in the past. And we know that it will.

Organization Meeting On Friday night, October 22, the Cornell Association of Civil Engineers got under way for the term by having a general organization meeting. Officers elected to carry out the policies of the Association for the coming year were as follows: President, T. C. McDermott, '21; Vice-President, D. G. Cockerott, '21; Secretary, J. J. Chavanne, Jr., '21; Treasurer, F. A. Regan, Jr., '21; Athletic Director, R. S. Anderson, '22; Faculty Director, W. L. Conwell, '11.

Plans and arrangements for future meetings have already been made, which indicates that this year bids fair to be one of the most successful years in the history of the Cornell Association of Civil Engineers.

Tau Beta Pi Elections. Fourteen men were elected to Tau Beta Pi, honorary engineering society, of which nine are in the College of Mechanical Engineering, two each in the Colleges of Civil Engineering and Chemistry and one in the College of Architecture. Prof. Myron Adolph Lee, M. E. '09; M. M. E. '11, was one of the men elected from Sibley College. The two men from the College of Civil Engineering who received this high honor are Harold Ingersoll Hettinger, '20, and Norman Carl Wittwer, '21.

(Continued on page 44)

ALUMNI NOTES

'75. Edward George has returned from his trip to England and may again be addressed at Nassau, N. P., Bahamas, B. W. I.

'78. Frank E. Bissell is Chief Engineer with the A. S. Hecker Company, General Contractors, 8701 Union Avenue, Cleveland, Ohio. His home address is 10515 Wilbur Avenue.

'81. The firm of Smith & Davis, Consulting Engineers, having been dissolved by mutual consent, Miller A. Smith announces the organization of a new firm, known as Smith, Ames & Chisholm, Consulting Engineers, with offices at 508 Lonja Building, Havana. The new firm will specialize in all engineering work connected with the sugar and transportation industries of Cuba.

'87. Lyle F. Bellinger now has the rank of Lieutenant Commander in the Civil Engineering Corps of the United States Navy. He is public Works Officer of the Eighth Naval District and is stationed at New Orleans, La.

'88. Charles N. Green is with the Osborne Engineering Company, Cleveland, Ohio.

'88. In addition to his private practice as consulting engineer and his work as chairman of the Manitoba Drainage Commission, John G. Sullivan has been retained by the Department of Railways and Canals of the Dominion Government to assist in preparing the case of the Grand Trunk Railway arbitration, in which case former President Taft has been appointed arbitrator for the railway company. Sullivan may be addressed at 703 McIntyre Block, Winnipeg, Manitoba.

'91. Carl H. Niemeyer is Assistant Chief Engineer of the Eastern Region of the Pennsylvania Railroad, Philadelphia, Pa. He resides at 206 Corrhshoeken Avenue Cynwyd, Pa.

'92. Charles C. Huestis is President of the Carbon Mining Company, Carbon, Ind. His home address is 604 North Meridian Street, Brazil, Ind.

M. C. E. '93. Harry T. Cory has returned from Egypt where he acted as a member of a commission of Consulting Engineers, having been given a leave of absence from the U. S. Reclamation Service for that purpose. He visited the University in September.

'93. William R. Doores, who is a Colonel in the Coast Artillery Corps, U. S. A., is now located at Fort Totten, New York.

'94. James L. Dodge is Plant Engineer of the Hog Island Ship Yard, Hog Island, Pa. He resides at 253 Lake Avenue, Pitman, N. J.

M. C. E. '95. Charles W. Sherman of Metcalf & Eddy, Boston, Mass., has been nominated for the Presidency of the New England Water Works Association, for 1921.

'97. Ira W. McConnell has been nominated for

the position of Director of the American Society of Civil Engineers.

'00. Squire E. Fitch, who is Superintendent of Maintenance, New York State Highway Department, gives his home address as 42 Academy Street, Westfield, N. Y.

'01. Collingwood B. Brown, jr., Chief Engineer, Canadian National Railways, Moncton, N. B., has been appointed engineering assistant with headquarters at Toronto. He is Vice-President of the Association of Professional Engineers of the Province of New Brunswick.

'05. Mr. and Mrs. Harold I. Bell, of Portland, Ore., announce the birth of their son, Gordon Humphrey, on September 25. Mr. Bell is office manager of the H. P. Cummings Construction Company of Portland, Me.

'05. Major Harry F. Porter, Q. M. C., is on duty at Fort Monroe, Va., as construction quartermaster for the coast defenses of Chesapeake Bay.

'05. Thomas Fleming, jr., is now engaged in private practice as a Civil and Mechanical Engineer at 215 Water Street, Pittsburgh, Pa.

'06. Edward A. Evans is a Construction Engineer with E. I. du Pont de Nemours & Company; his address is 1401½ Riverview Avenue, Wilmington, Delaware.

'07. R. Menees Davis, who is Statistical Editor of the Electrical World, New York City, is now residing at 36 Queens Road, Queens, N. Y.

'07. Ford Kurtz is Engineering Supervisor of the J. G. White Corporation, 43 Exchange Place, New York City. His home address is Palatina Avenue, Hollis, Long Island, N. Y.

'08. Alvin L. Gilmore, Consulting Engineer and Vice-President of the Binghamton Bridge Company, is now living at 185 Washington Street, Binghamton, N. Y.

'08. George C. Hanson, American Consul at Foochow, China, was on leave of absence in the United States this summer; he sailed for China from San Francisco on October 14.

'08. Philip B. Hoge, who has been with the C. E. Knoeppel Company, of New York City, is located at 815 Cross Avenue, Elizabeth, N. J.

'08. Elliot Vandevanter has been appointed a Captain in the Corps of Engineers, U. S. A., as a result of the recent examinations.

'09. Hart Cummin, who is engaged in municipal engineering work, has changed his address to 325 South Walnut Street, Lansing, Mich.

'09. Clarence F. Fisher, who is Superintendent of Landoff-Bicknell Company, Cleveland, Ohio, now resides at 367 East 149th Street, Cleveland, Ohio.

'09. Arthur W. Harrington is Hydraulic Engineer with the U. S. Geological Survey and his address is 704 Journal Bldg., Albany, N. Y.

CAMP REPORT

(Continued from page 38)

running the circuits. A gauge for reading of the elevation of the surface was set up near the site camp and was read every half hour while these leveling runs were being made.

Hydrography

This portion of the survey was under the supervision of Professor Lawrence. The first few days were spent in locating and establishing signals for the sextant work, whitewashed rocks and cloth signals were used for the most part. The actual sounding covered an area extending roughly across the lake from Sheldrake Point and extending as far north as the triangulation station Wyer.

The Utowanna was used to convey the sounding crew of eight men up and down the lake. In the party, one man kept the notes, two men plotted the soundings as they were taken, two men manipulated the sounding machine, two men read the small angles and one man read the check angle. The total number of soundings taken were eight hundred, and the average for one day was ninety.

Astronomy

The work in astronomy was under the direction of Professor Underwood. Each student was required to take two sets of readings on the sun from some line in one of the traverses of their party so as to determine the true azimuth of the line. These results were required to check within one minute. In addition each student was required to observe on the stars for azimuth, time and latitude of a line in camp.

Camp Duty

Camp duty was under the charge of Mr. O'Rourke, and consisted of the routine duties of camp maintenance. It comprised the airing of the tents, disinfecting the latrines, filling the lamps, emptying the refuse barrels, cleaning up the camp, and keeping the water tank pumped full of water.

Camp Notes

Another of the evils of prohibition was discovered when cider was found to possess the same effects as sunstroke. This potent liquid is one of the daily beverages of the natives of the Corners.

It is said by some of the ones who ought to know that the conductor of the 4:37 A. M. train is still looking for the fifty engineers as his train passes through a certain corner daily.

We still wonder where the horn possessed by one of the camp officers disappeared to and also where the tin dishpan was procured. Any one having knowledge of the above fact will please keep said knowledge to himself.

There are rumors that Mr. Perry is still occasionally looking for (a) Raulh.

NOTICE TO COEDS: The unevenness of mustaches on certain members of this camp may be at-

tributed to the great difficulty with which the tonsorial art was practiced on the Utowanna one week-end on the trip to town.

Conclusion

It may be said that in spite of the late start on the survey due to the inclement weather at the beginning of the summer every part finished its work in time. Although there were several night shifts the last few nights on some of the more difficult maps, and triangulation was carried on rather late once or twice, these shifts were the exception rather than the rule.

The camp was under the supervision of Professors Underwood, Conwell, George, Lawrence, and Weber, and Messrs. O'Rourke, Pendleton, and Perry.

The camp officers were as follows: F. W. Lake, Chief Engineer; A. H. Kohler, Assistant Engineer; W. G. Cobb, Quartermaster; F. E. Conklin, Assistant Quartermaster; F. Delaney, Commissary.

COLLEGE NOTES CONTINUED

The outdoor tennis season has closed but **Tennis.** for the real tennis enthusiasts here at Cornell it means that the indoor season is to begin. A meeting of those interested in tennis has been held with a view toward improving and enlarging the facilities for playing the racket game. A committee has been appointed, headed by Graduate Manager Romeyn Berry '04 to proceed with suggestive plans and arrangements for carrying out the main idea which prompted the holding of the meeting. As soon as the football season closes the plans of this committee call for the opening of indoor tennis courts in the New Armory so that all those interested in tennis may keep up and improve their skill in the game. It is also planned to hold an indoor tennis tournament on these courts similar to the tournament that is held on the outdoor courts.

The following were elected to Pyramid, **Pyramid.** the Junior Honorary Civil Engineering Society: F. A. Regan '21, R. S. Anderson, '22, R. W. Calloway, '22, B. S. Corney, '22, R. W. Leitch, '22, H. G. Furst, '22, L. W. Hoyt, '22, W. H. Van Pelt, '22, P. H. Wood, '22.

The prospects of the wrestling team **The Wrestling Team.** for this year are bright, although there are only two "C" men back.

Last year Cornell was defeated by Penn State, but, previous to that, Cornell had held the intercollegiate championship for eight years. The schedule for the year includes meets with some of the best teams in the East, among which are Pennsylvania, Penn State, Lehigh, Columbia, and Princeton.

(Continued on page VII)

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A BRIEF DESCRIPTION OF CALIFORNIA HIGHWAYS

(Continued from page 34)

for work on the roads, and allowed certain additional credits on time. On one job near the State prison, the men were hauled to and from the prison daily. Generally the work is located at a distance from the prison, and a construction camp is necessary. The highway commission furnishes a competent superintendent in charge of the entire camp, and the prison authorities furnish a number of guards, who in addition to acting as guards to the prisoners, serve as foremen under the superintendent. Sometimes a small number of free men are employed at these camps also. Convict labor so far has proved cheaper than free labor, and can be utilized to advantage in localities in the mountains where free labor would be difficult to get. To insure convict labor being an entire success requires an unusual type of man for superintendent, and the closest co-operation between the highway and prison authorities.

Status of Engineering—The status of the engineering profession in this State, as affects highway work, may be of interest to the readers of the Cornell Civil Engineer. There were in the employ of the Commission a short time ago about 400 engineers of all grades. Quite a few men have left recently for other localities where highway work is opening

up, which localities often call on the engineers trained in work in this State. The salaries range all the way from \$10,000 per year for the Highway Engineer and \$5,000 for the Division Engineers, to about \$1,200 per year for rodmen, etc. The salaries paid are on the average as good as or better than are paid in other States. The American Association of Engineers has a large membership in this State, and each Division has a highway section to look after the interests of its members, with a central section located at Sacramento. These sections cooperate as a solid unit in securing results, and have already done good work. The recently formed State Assembly also is active, and just now the licensing law seems to be taking up its earnest attention.

COLLEGE NOTES CONTINUED

Golf is again coming into its own in the Golf. University. This fall a tournament for the fall championship was played in which three flights of eight men each qualified. The championship flight was won by I. C. Ralph, '22, of Buffalo when he beat J. L. Hukill, '22, 5 and 3. Coming in Ralph established a new record for the course—a 35. The previous best score for the course had been 36.

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CLEVELAND'S SUBMERGED OUTFALLS FOR THE DISPERSION OF SEWAGE

(Continued from page 29)

one-half (1-2) mile in width and from two (2) to three (3) miles in length, gradually diminishing in intensity toward the limits of this area. While the area about the West 58th Street multiple outlet appears more turbid than the surrounding lake water, this sewage field cannot ordinarily be noticed from shore. The discoloration probably does no particular harm; nevertheless, it has its sentimental effect upon residents along the lake front in continually reminding them of the presence of sewage in the lake water.

The presence of sleek and oily areas about the outlets is probably visible only from boats in the immediate vicinity and is not noticeable from shore.

Throughout the observations very little notice has been made of odors about the outlets except the stale sewage odor which may be traced quite a distance from the point of discharge particularly in the direction of the sewage-polluted area. Septic odors are only noticeable during warm weather when masses of the sludge are being gas-lifted.

It is believed that the discharge of crude sewage into the lake through any type of outlet will result in the formation of a sludge carpet upon the lake bottom, and that the effect of sewage treatment in reducing the extent of such carpet will depend upon

the quantity of sewage solids removed by the treatment processes. Due to the distribution of these solids through a multiple outlet the thickness of the mat formed should be decreased and hence the tendency of the material to rise to the surface in large masses should be diminished. While smaller masses may be gas-lifted they will be less likely to find their way to shore but will be more easily scattered through the lake water. Under like conditions it is believed that no appreciable difference in the amount of solids stranded upon the bathing beaches will be noticed in the use of the two types of outlet. The multiple outlet should, however, reduce considerably the intensity of the discolored area as well as the odors in the immediate vicinity of the point of discharge.

General

Robert Hoffman is chief engineer and commissioner of the Division of Engineering and Construction, of which the Sub-Division of Sewage Disposal is a part. The work of design and construction herein described was under the supervision of George B. Gaseoigne. A. C. Lucas and William L. Havens were the resident engineers in immediate charge of construction and the Great Lakes Dredge and Dock Company and the American Construction Company, both of Cleveland, were the contractors for the Westerly and Easterly concrete outfalls, respectively.

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ANALYSIS OF THE CENTRAL ELECTRIC STATION INDUSTRY IN CANADA

(Continued from page 36)

plies and working capital. The commercial stations reported 71.7 per cent of the total capital and the municipal stations 28.3 per cent.

The total revenue from the sale of electrical energy reported by all stations is \$53,549,133, the commercial stations reporting 62 per cent of this total and the municipal stations 38 per cent. This revenue includes the income received from the re-sale of energy purchased in bulk by one central station from another central station. The re-sale of energy by a second station must obviously take care of the purchase price of such power and the distribution charges.

Capital Invested in Hydro Central Electric Stations and Systems

In order that the part played by hydraulic power in this industry may be properly appreciated the capital invested in hydro generating stations should be considered in conjunction with that invested in stations of the non-generating type which purchase power from hydro generating stations. For the Dominion the total is \$364,479,961 representing a total investment of \$218 per installed turbine horse

power and accounting for 90.7 per cent of the total capital invested in all central electric stations in Canada. As this capital includes investments in fuel power plants which are operated as auxiliaries to hydro-plants the capacity of the primary power machines of these plants added to the capacity of the hydraulic turbines gives a more logical basis for this analysis and reduces the capital investment per installed primary horse power for the hydro stations to \$203. The capital invested in water and fuel power central electric stations is represented graphically in Figure 2.

The results of this census show a decided activity in the development of electrical energy for central electric station purposes. This activity is particularly evident from the reported contemplated enlargements to existing plants as well as from the new developments at present under construction and the extension of the already notable transmission systems of the larger stations. In connection with enlargements of existing plants the hydro generating stations reported new installations contemplated for the immediate future amounting to 135,755 horse power. The ultimate designed capacity of existing hydro-electric central stations is 2,115,043 horse power.

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EDITORIALS

The New Problem.

The various events and incidents that have taken place in the affairs of the national engineering societies during the last two years are of so great importance to and have such a direct bearing on the future of civil engineering students of to-day that he can no longer neglect to give them some thought. The amazing and rapid growth and prosperity of the American Association of Engineers ever since its organization, the bitter and unrelenting fight which has been and still is going on between the two factions of the American Society of Civil Engineers; and the formation of the Federated American Engineering Societies are only three of the very important topics which merit considerable attention on the part of present-day civil engineers. Of these, the growth and prosperity of the American Association of Engineers presents, perhaps, the most interesting problem, and brings up the question, "Should there be a student chapter of the A. A. E. here at Cornell?"

The American Association of Engineers, following its policy of expansion so as to include in its membership engineers from all walks of life, has started to establish student chapters at technical schools, colleges and universities. Their purpose in doing this is to get the engineering student interested in the affairs of the Association and through the Association, in the affairs of the outside engineering world. Student chapters of A. A. E. have already been formed at several of the schools of the middle west, and all are progressing excellently. But although the western schools have accepted and enthusiastically endorsed this idea, yet there is no eastern school, to our knowledge, at which a student chapter of the A. A. E. has been formed. Perhaps it is because the west is more progressive than the east. Of late years it has certainly seemed to take more interest in new things, in new methods, and in new ideas and to respond more quickly to the impulse of the new than the more conservative east. But is this the main reason for the lack of student chapters of A. A. E. in the east? The CIVIL ENGINEER has sounded the opinion of a few members of the faculty here and some of them seem to hesitate in sanctioning

the establishment of a student chapter of A. A. E. here at Cornell. Some say that it is a comparatively new organization which has not yet proven its worth to stand the test of time; others say that we already have too many engineering associations and societies here at Cornell; and still others maintain that in spite of what the members say, the A. A. E. does not uphold the highest kind of ideals to an engineering student. On the other hand, several members of the faculty are of the opinion that a student chapter of A. A. E. would be a great help to the engineering students here at Cornell. They state that A. A. E. has already proven its worth in the engineering world through its membership of over 25,000, by securing substantial increases in salary for some classes of engineers, by adopting wage scales, by giving engineering employment service which is excelled by none in the world, and by having the Railway Board decide to use this service as its official employment agency. All agree, and the CIVIL ENGINEER agrees with them, that there ought to be a branch of some national civil engineering society here at Cornell. And if the A. A. E. were not eligible, what other national civil engineering society would inaugurate one of its chapters here? Unfortunately, none. The American Society of Civil Engineers seems to be too engrossed with the dissension in its own ranks to pay much attention to the welfare of the future engineer. It seems to have enough trouble looking after the present engineers and does not make a practice of establishing student chapters at any university to interest the engineer of the future in what is really the best engineering society in the world to-day. And we are at a loss to account for its neglect of the budding engineers when we think of our classmates over in Mechanical Engineering and Electrical Engineering enjoying all the privileges and benefits of being student members in the American Society of Mechanical Engineers and American Institute of Electrical Engineers, respectively. It seems that A. A. E. is filling a sore felt need by establishing student chapters and that it is asserting its rights to a field which could and should have been annexed by the American Society of Civil Engineers years ago. If the A. S. C. E. does not stop its internal squabbling

and try to get the student interested by establishing student chapters, why should the student try for membership after graduation, when the A. A. E. really interested him during his student days?

In the first part of this discussion we have considered in a general way the conditions as they exist in the various national engineering societies today. But the real problem for the civil engineering student here at Cornell arises upon asking the questions, "What are you going to do about getting a student chapter of a national engineering society here?" "What is going to become of the present Association of Civil Engineers of Cornell University?" Our suggestion is that the students of the College of Engineering unite in applying for a student chapter of the American Association of Engineers. The special undergraduate engineering societies such as the Association of Civil Engineers, and the student chapters of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers would not be affected by the formation of a student chapter of A. A. E. The A. A. E. chapter would embrace all three present societies, yet would not supersede them. The membership of the chapter would be composed of civil, mechanical and electrical engineering students and, through this membership, would bring all engineering students together and create a feeling of brotherhood between them—a feeling which ought to be prevalent but which is sadly lacking.

A New Method of Teaching. Professor McCaustland, Dean of the School of Engineering, at the University of Missouri, formerly Professor of Civil Engineering in Cornell University, at a recent conference in Chicago, said that "personnel" work is necessary in engineering schools and should be provided wherever possible. This is a modern way of saying that students in engineering should be selected and trained because of an estimated value set upon their natural talent for the profession, rather than because of their own wishes. It is virtually saying that modern efficiency demands that an external authority shall say what niche in life a man shall fill. It subordinates the interest of the individual to the welfare of the state. In times of war such a policy may be justified but in the college world there can be no adequate authority for such action however much the analogous idea of factory efficiency may suggest it.

The factory idea, back of the resolution embodying Dean McCaustland's sentence quoted above, is not new though it is here freshly clothed; it is that under present conditions there is a great waste in engineering training, a waste due to the innate inferiority of the raw material. Men enter a technical school, not merely unprepared but unfitted by nature to profit by the labor expended on them. The science involved in engineering requires a logical,

balanced, thoughtful, comprehension of certain principles, laid down in the text-books to be learned, but profitable only if they can be completely apprehended. And many students enter college, ready to learn, i. e. to memorize, but with no power of honest independent thought. Alas! they often leave it with no better mental equipment. The art involved requires a detailed imagination, a power of visualizing a structure complete, ready to operate, designed in conformity with that particular phase of the science that applies. To attempt to teach a poet, either the science or the art is, it must be admitted, wasted effort and because of the effort many misfits are graduated with low standing and without power of later development. Birdseye, in his arraignment of colleges, compares the waste pile of a factory to that of a college, emphasizing the number of students who are dropped from the course and intimating that it is the fault of the faculty if the college does not turn out 100% of perfect product. The college cannot do this for many reasons, but no one can deny that the number of competent engineers graduated is a lamentably small percentage of the number of entering freshmen. To assume however that a personnel officer with unlimited power to test and examine prospective students could change the present percentage is to try vainly to transfer the conditions of war to the times of peace.

To improve the efficiency of the schools and to secure the result aimed at in the resolution, another improvement in educational methods suggested in late years seems more promising and consists of a revised method of teaching. Partly because of the traditions of the venerable Arts College, and partly because of the practical difficulties due to inexperienced teachers, engineering is generally taught like mathematics or language, viz., a series of principles, rules, and illustrations or examples to be remembered and recited. The "Project" method, on the other hand, sets forth a problem and stirs the student to active mental interest in finding a solution. By this method he is confronted with a definite task, lacking in tools, and is judiciously guided into knowledge that elings and is usable because it has been tested. To learn about moments because a beam has to be designed is far more interesting than to learn abstractly the theory of moments with all its variations. Mental discipline, to be sure, must be secured and there is no royal road to knowledge. But to start a class in bridges by having them climb up on the top chord to sketch the upper lateral system gives a reality to blackboard outlines of trusses that vitalizes the theory involved. To arouse interest is not merely a kindergarden method but a sound principle of good teaching. If technical schools can come to adopt this way of stirring the immature minds of students, not only will mental power be vastly increased and a higher standard made possible, but those unfitted and incompetent will be more safely and surely eliminated.

H. N. O.

THE ENGINEERING OF MEN

A Talk by WILLARD BEAHAN, C. E. '78, M. A. S. C. E., M. A. R. E. A., M. A. A. E.

At a Joint Meeting of the American Society Mechanical Engineers, Engineers' Club of Philadelphia, and Affiliated Societies.

"The Most Difficult and at the Same Time the Most Important Branch of Engineering is the Engineering of Men."

I SHALL speak of the engineering of men to-night mainly from the standpoint of the engineer and as a member of this society. If one endeavored to speak of the problems of labor and capital, this hour would be all too short. As a caption for this paper I use a law laid down by Robert Stephenson, one of the fathers of engineering. That statement is nearly a century old. Robert Stephenson was the son of George Stephenson, who was the father of railroad engineering, and who built the **Rocket**. The first locomotive that was run in this country was built by Stephenson and his companions. In those days civil engineering was not at all subdivided. We had civil and military engineering. We did not have any division between mechanical and civil engineering.

George Stephenson built the **Rocket**, as you know, in 1826. He had become prominent as an engineer of railroads, inventor, and promoter. He really became the first railway engineer of the world. Now this George Stephenson laid down a law some hundred years ago and we have not yet reached to the horizon of that law. It is this: In speaking of the means of transportation, he said:

"Competition is impossible wherever combination is possible."

You put that law alongside the law which I have first laid down, given by his son, and you have shown the engineer of to-day his two largest problems, and you have given a horizon in each of those problems which is broader than many of our visions can compass. George Stephenson did not live a great while after the **Rocket** was built, but his son, Robert, lived a long time, and it was in the later years of his life that he laid down this first rule for us. I want to call your attention to this fact—that these fathers of engineering, father and son, and the men of their time, not only made the plans of their engines, of their bridges, and their roads, but they promoted the project through Parliament and before Boards of Trade. They raised the money; they built the roads; they handled their own men; and they completed the work.

That was the way our profession started. As we grew, and especially in America, the development of the country was such that our profession could not possibly keep pace with it. The result was that, more and more, that part of engineering which could be lopped off was taken away. The legal end, the promoting end, the financing end were the first to go. Not so many years ago, I can quite easily remember it, contractors came to be general

in this country—we still have with us a few of the engineers who never employed contractors. Capt. James B. Eads, who built the St. Louis Bridge, the steel arch of which is the biggest steel arch, I think, in the world, was foremost among those who promoted that bridge. He convinced the people it could be built, that it ought to be built, and he convinced Congress. Mr. Eads, to a marked degree, prosecuted his work in this country as Stephenson did in England. Gen. Grenville M. Dodge, who commanded the Sixteenth Army Corps during the war, and made a mark for himself with Grant for his rapid construction of bridges, was also a great railroad engineer. It was my privilege to serve under General Dodge in the 80's in Texas. To a large extent, he planned, financed, and completed his own works through improvement companies, which were really the general contractors.

I maintain to-night that we have drifted too far away from the ideals of the fathers in engineering, and that all this is because we were driven to it. It came to pass, not many years ago, that about all that an engineer did was to make the plans, drive stakes, and let the contracts, and we have finally come, my brethren, until, as a prominent labor man lately said to me, "that about all that a railroad company can say now in labor questions is to pay the bills."

We have drifted so far away from the ideals of the fathers that we are of much less use to the world than we should be, and I wish to say that this society saw that a few years ago, and the very fact that we are domiciled in the Chamber of Commerce is evidence of our new vision. The making of a plan, the letting of a contract, and driving some stakes, which are followed more or less closely, is not the highest form of engineering; and if I do not say anything else to-night that you young men will remember, I want to say that we are not coming up to the ideal of the Stephensons. We have spent too much time in testing materials, and work of that nature, and we have spent very little time in engineering the men. We have turned that over to the men with thick shoe soles, brass watch chains, and heavy voices. The most important branch of engineering is the engineering of men, and that is the branch that we have turned over to other people.

General Laws

The first law I would lay down in the engineering of men is a very old law, but in my judgment it is fundamental. Some call it the Golden Rule. You

will find it in the 6th chapter of Luke, along about the 31st verse. Freely it reads:

"Do unto others as you would that they should do unto you."

As engineers, we have gotten a good way from that. We have found out, I suppose, that it takes quite a brave man to lay down that rule in the handling of men; but when as an employer of labor, or a supervisor of it, I forget that law and fail to treat those men as I should like to be treated, I am bound to have trouble.

The second law is that very good one of the army officers of West Point, and is compassed in that little phrase they term "caring for their men," meaning looking after their needs, their wants, their happiness, their welfare. I would place that alongside of the Golden Rule. An army officer, be he ever so brave, is not a success if he neglects to take care of his men. The high-water mark of warfare on this continent was at the battle of Gettysburg. In Pickett's charge, General Hancock, with the Second Army Corps, was withstanding that charge. Hancock was wounded a few minutes before Pickett started, and he was wounded while writing on the horn of his saddle an order to his commissary to bring up fresh meat for his soldiers for supper that night. Even in the awful stress of that critical moment, Hancock cared for his men.

I think that bears me out that the care of men is one of the first laws to be observed in the engineering of men. I have heard many men from West Point say: "We have many men who can **fight** a brigade, but fewer who can **handle** a brigade." It is easier to lead a charge than it is to take care of a brigade two weeks. In the engineering of men this is the second principle I would state.

The third law which I would have you remember is this: Men carried on your pay-roll must be carried on your heart. Whether you pay the men or not; if you have to sign the roll on which these men's names go in, month by month, you must carry those men on your heart. You are responsible for their welfare, you are responsible to see that they get their pay, the last penny—and even a little further than that—the last penny that **they think they ought to have**. You are responsible to see that they get their money in time; that they are promoted; that their rates of pay are equitable, especially of the younger ones. More than that, you are responsible for the married man, especially. If he is a father, so far as you can, allow him to work as near home as the interest of the company will permit, if it does make you a good deal more trouble. That is what I mean by carrying them on your heart. If you don't do that you are not an engineer of men. If you don't do that the Almighty will some day call on you to know why you did not. If you did that there would not be so many strikes.

Principles in Organization

In the organization of your work and blocking it out, there are three things of prime importance: Personality, organization, and treatment. If I may reverently paraphrase—"There abideth personality, organization, and treatment, these three, but the greatest of these is **treatment**."

The personality of the superior at the head of an organization is a very important matter. The bigger the organization, relatively, the more important it is to have the right kind of man, but even if there be but one gang of men, the personality of that gang boss is very important.

In an organization, I believe in military ideals. If you can imagine a military organization without the shoulder strap, then that is what I believe in, and I have worked with army officers a great deal. There must be discipline, there must be responsibility placed upon one head, and it must be recognized. If you cannot respect the man above you, you must at least respect his position. Don't forget that. That is the army idea.

It does not follow that the ranking engineer of an organization is the best engineer. Let me illustrate: We were building the Texas Pacific in the early 80's, and as these men have passed away I can mention them. One of the men, Major Washburn, a West Pointer, was in the artillery at Little Round Top at the battle of Gettysburg. There was at Fort Worth, Texas, where we had our headquarters, a Major Patton. I think he was a Kentucky major, I do not think he ever was in any army. There was in our organization a Mr. Lawrence, who had seen splendid service on the Union side and was a very brilliant, brainy locating engineer, but sometimes given to drinking too much. He happened to be in Fort Worth, and I suppose had been drinking, and said one night that he was a better locating engineer than Major Washburn. Major Patton heard this remark, and he, wishing to curry favor, said to Major Washburn: "Major Lawrence says that he is a better locating engineer than you are." Major Washburn replied: "I believe that is true." Whereupon the Kentucky major said: "Why, do I understand that you would have a man under you who claims to be a better engineer than you are?" "Oh, yes, I am very glad to have them. I wish I had more of them. Now, for instance, there is Mr. McL., who is a better construction engineer than I am; Mr. L., who is a better maintenance engineer." "That is all very strange," said Patton. "No," said Washburn, "they are all better engineers than I am, but I suppose that the people in New York, General Dodge, the president of our company, consider that on the whole **I am the best man for chief engineer**." He was the best all-around man. He was quite good in all departments. He was a fine organizer. He knew how to handle men.

The worst mistake we make to-day in organizations is experimentation. In railroads it is pitiable. I saw but a few winters ago, in **The Railroad Gazette**, an entire page occupied with the reorganization of a certain railroad in a certain way and giving the reasons for it. On the next page, another road, it was announced, was reorganizing from the organization which the first road were abandoning, as they were instituting something else. One company or the other was making a mistake. One company should not have abandoned it, or the other company should not have taken it up. We are in the kindergarten stage, so far as that is concerned. We men in railroad service know it means a great deal of expense, a great deal of distress, and it takes us a long while to get our bearings.

The third great requisite in organization is treatment. I think if we could get back—which we never can—to the English idea of master and servant, we would be doing something very much to be desired. It would save us a great deal of money and do away with a great deal of friction. The master and servant idea was this: A man hired a boy, took him into his family, fed him, looked after him, paid him, and he lived with that boy for a term of years. We cannot do that now, but some one must come pretty near doing that for us. We must pick out the men to whom to delegate it. I suppose that many of you think that it is entirely visionary and impractical. No, it is not. The Chicago and Northwestern Road has come very near that idea tonight, because Mr. Hughitt, chairman of the Board, believes in it. Here is Mr. Hughitt's rule: If a man has been in the employ of the company five years he cannot be discharged without a hearing. If the charge against the man is incompetency, Mr. Hughitt would say, "It seems to me it has taken you entirely too long to find this out," or "You should have found it out before five years." That applies to even such minor positions as brakeman. If a man thinks he has been improperly used on the Northwestern he can appeal to the President and the President investigates. When I was there I said to my informant, "I should think it would take all the President's time." He said, "Oh, he doesn't get so many cases. We all give heed to that." Good treatment will win devotion. A raise in pay will not quickly win devotion. We think if the company would only allow us to pay bigger salaries, we would get and keep the best men in the country. There is no greater fallacy. It confesses our weakness.

Engineering Organization

The simplest form of organization is that for the project engineer. The first requisite, in my judgment, is to put a man in charge of that project with engineering education, whether he acquired it in college or somewhere else. I do not believe in put-

ting a man on a job who has not been in that particular kind of work. I do not believe in putting him in charge because he is simply brilliant. I would put a man in charge of that work who has had experience in that kind of work, and I want him to be forty years of age. I was put in charge at twenty-five. He must know human nature. He must be in full charge of all the features of the work.

"Well," you will say, "that is difficult." Very well, there is the first difficulty you are going to meet. If you divide the responsibility at all, then when there is a mistake made there is no one you can hold responsible. Your chief of party should always be able to do any work under him fairly well. In order to do that, he must practically come up through the ranks. His first assistant must be but a little less able. He must be an understudy. In temporary illness he must be able to carry on the work. There should always be an understudy in **every position**, so far as that is concerned.

Allow me to say in parentheses that I have a great sympathy for young men whose fathers are vice-presidents or large stockholders. I am not one of those who degrade that kind of man. I have seen some sad things in that direction. Don't make the mistake of putting him on work he cannot do, and then hiring another man to do the work. You are trying to curry favor and build yourself up at the expense of that young man just because his father is vice-president. I have had more than one young man come to me and beg of me not to let the men know his father is vice-president. Plenty of men in this country are handicapped by their wealthy, or their great, fathers. I am sorry for them.

Have your office for this project or piece of work in the middle of your work. If it is a piece of construction work, have your best assistant in charge of the office, never the chief clerk. This has been the day of the chief clerk, and he is passing. The rubber stamp and the chief clerk have cost many a heartache and many thousands of dollars. It comes from the fact that you and I in charge of the work are overloaded and are jealous of our understudy. "If we get a good assistant, he will get our job," we think, so we put a chief clerk in and somebody else gets our job. Our centralization is killing us. It killed Harriman. You will rule your work—this project I have outlined for you—if you rule it at all, by reason of your engineering and your manhood. If you are that kind of man, it is easy to control the project and have your success.

The heads of even the smaller engineering projects or enterprises must "sit tight." Troublesome times will come. With your work well lined up and the best engineers and labor there will come times that try men's souls. Then you need to have faith and the staying qualities of the heroic sergeant of whom Kipling says:

He's just as sick as they are,
 His heart is like to split,
 But he works 'em, works 'em, works 'em
 Till he feels 'em take the bit;
 The rest is holding steady
 Till the watchful bugles play,
 And he lifts 'em, lifts 'em, lifts 'em,
 Through the charge that wins the day.

Labor Problems

The engineer of men in the broadest sense must be twofold, an engineer and a student of men. An engineer of design is not an engineer of men. He is an engineer of plan, specifications, and of material. An engineer on the frontier, as General Dodge told us, had to be engineer of men, or the Indians would get him and his men both. (Laughter.) The man, I have said, who is in charge must have absolute charge, and in the control of men—that is the first thing.

If you expect to control labor in general—and I am now speaking of ordinary labor—three things are necessary: First, there must be no dispute but what you have the authority, and the men must know that. You are in authority, you are the boss, if you are handling men, whether a few or a few hundred men. Battles have been won by a poor commanding officer, but no battle was ever won by a debating society.

A second requirement is that you must be absolutely right—legally, morally right. That the right is on your side and beyond dispute. I can best illustrate my meaning by an incident.

In 1898 I was superintendent of the Cascade Tunnel for Mr. James J. Hill, of the Great Northern Railway. It was a company job. I was superintendent, another man was engineer. We went up there in August. We started in with no organization and no men; cleared the ground, got a few men at a time—we gathered there four hundred men—driving the tunnel two and three-quarters miles, working from a camp at each end. We boarded the men. We had our own store, and our own doctor and hospital—a little community by ourselves. There were some saloonkeepers who came in—we held them off our certain reservation. We made our rules that applied to them. We had our own camp bosses. There was a county line crossing at the center of the tunnel and each of the camp bosses was sworn in as a deputy sheriff in his own camp county. They had been peace officers at home. While all the men did not know it, I was deputy sheriff in each county. When a man got bad, we looked him up, and wired for the sheriff to come and get him.

The incident I am about to relate happened in February. I had not been put in charge of the dining-rooms. We had an engineer in charge of the maintenance, and, thinking the work would be heavy for me, the dining-rooms were still in his charge. He had put there as commissary clerk a conductor from the dining-car service. Now, of

course, he would not know how to feed **these** men. He got us in trouble. The snow was very deep, lying twenty feet on the level. The only trails were where we walked. There was no such thing as straying out of the path. The men did not know I was in that particular camp. I had just passed the dining-room—our men worked in three eight-hour shifts—I saw the men coming out of two of the company's quarterhouses. There were one hundred men. It was snowing very hard. I suspected they were coming out for mischief. They came up the trail, going toward the dining-room. I waited for them:

"How are you, boys? Going up to the dining-room? A little early for dinner, aren't you?" This was about half-past two, and the next meal was at four o'clock.

"Yes, but we have a little business up there," one of them said.

"Well, am I invited?"

"I don't know about that," was the reply.

"What's going on?" I asked.

"We are going up there to hang the commissary clerk." (Laughter.)

"Oh, well, I don't think it is very polite of you to neglect to invite me when there are such festivities as that. What's the matter with the commissary clerk?"

Really, it didn't amount to anything. I asked them some questions, got all the facts.

"Now," I said, "do you think you are treating the company right to create a scandal of this sort, as it will do? Aren't you acting like fools here? Now, suppose I let you go up there and do it, which I am not going to let you do, you can't get off this right-of-way without we allow you to. The snow is twenty feet deep, you can't walk down the track. We will load you up and send you down to Seattle; a lot of you will get hung. Another thing, how will this look when it gets to St. Paul to-morrow morning? Is that treating the company right? You are supposed to be American citizens. You think you are fit to be citizens and voters in this country. This man hasn't done anything. Do you think you are treating me right? I am the superintendent out here, and I am responsible."

"Well, we ain't got anything against you."

"You haven't! Now, you fellows go back into your 'quarters,' and if you have a grievance I will listen to you, and if you don't, I will have to strike first."

I talked to them pleasantly, reasonably. Some eighty men in the background wandered back. They hadn't anything against me. They didn't want to be hung. The leaders wouldn't stir. I suppose there were some ten to fifteen of them. I could not do anything with them. The first leader I knew very well. I had routed him once before, a Cornish miner, surly and thickheaded; another was an Irish-

man, my own nationality. No use to argue with those men, they were beyond argument. There they were, the snow was coming down pretty lively.

"Now," I asked, "have you got anything more to say? You fellows go back to your bunk-house." Not a man moved. I drew my toe across the path, and stepped back a pace or two. "That is all I have to say; come ahead, you can kill me at the last, but just as sure as you cross that mark I will kill six of you, and I think I can pick out the six who started this, and I will kill them first." They looked at me for a minute or two, and the Irishman said:

"Well, now, 'Super,' what is your proposition?" I said: "You go back to your bunk-house just as I have told you a dozen times, and in twenty minutes you send a committee around to my room at D quarters and I will tell you what I will do." They went back to the bunkhouse. Then I went back to the cook-house and saw the commissary clerk. In twenty minutes I met their committee, as agreed, and said:

"Now the main trouble is too small a cooking range; I will have another here as soon as I can."

"That is all right; we think that is fair," they said. That ended it.

Having the authority, and being in the right, the final thing in handling labor is that you must not be afraid. Let a hundred men come together, average men, and it is said that in thirty days one of that hundred men will be the leader. Now, I never knew a leader of that sort to be a coward. So, as an engineer of men, you must have that leadership quality. You will be surprised to see what you can do with it. I believe many of us fail right there. We are afraid. Afraid of the law; afraid of damages; physical fear; fear something is going to happen to us. Right makes might more than we think.

May I again illustrate from experience?

We were building the Texas and Pacific Railway for Mr. Gould in the early 80's. We began at Fort Worth and worked toward El Paso, the other terminal. By the time we had reached the Staked Plains, the Southern Pacific, our rivals, were nearing El Paso. We started then a second construction force out of El Paso to secure the choice of route down the Rio Grande River and up the best tributary suited to our purpose. To reach this grading, we must first build through Carizzo Pass of the Apache Mountains, 125 miles east of El Paso. Though but a youngster then, I was resident engineer of the work for ninety miles, including the pass.

We had been at work some five months the time of the incident I now relate. The pass could be traveled into or out of at the ends only. At the upper end was a grading camp of about one hundred men—mostly Irishmen. At the lower end was a camp of a little greater number of Mexicans. In

the center and just across the grade from the engineers' camp was a camp of sixty Chinamen. They had served their time of several years to the Six Companies and were free of any obligation. They were tall, strapping fellows, entirely different from our laundrymen, and each carried a pistol.

In this cosmopolitan camp there had been no liquor in the entire five months we had been at work. The Irishmen were certainly dry. The Mexicans resembled them in that one respect. The Chinamen were hemmed in, were armed and nobody loved them. Into this canyon there drove, one summer afternoon, two big wagonloads of whiskey, accompanied by six heavily-armed men. They unhitched their teams about in the center of the pass and were neighbors to the engineers and the Orientals. This saloon outfit had been the pest of the grading on the east end for two years. The track had gotten far enough across the Staked Plains, so the proprietor got across without dying of thirst. The contractor in Carizzo Pass tried to coax him to move on west. He tried to buy him off, all to no purpose.

"My work compelled me to ride nights, as the Apache Indians were bad. The next morning I reached that camp. The contractor and myself held a pow-wow, the engineer party being present. We decided what men we could depend upon and sent them word to be ready. The contractor started moving his pile of grain sacks and piled them in a crescent and left spaces for loopholes where needed between the sacks.

I wrote out a notice stating the company's case, that the saloon interfered with our business, menaced our lives, owing to the mixed races, trespassed on our land, and that we forbid his camping there. I signed it for and in the name of the company. I again saddled up the grand old Kentucky horse I then rode, buckled my weapons around me, rode down to their wagons, and called for the boss of the outfit.

There rose up a splendid specimen of physical mankind, wearing a fine pair of ivory-handled 44-calibre six-shooters. I handed him the notice. He read it twice. As he handed it back he said: "I suppose you know I'm not going to pay any attention to that. What's more, I've heard of you and I'm not afraid of you." I was encouraged. I saw there was some force to that notice and that fear was in his mind. Meanwhile the six ruffians had gathered around me, all around. I sat with my arms folded. I told them I was building a railroad. That we could not lay tracks **around** the heavy work in that pass. That the grading was going to be done before the tracks reached it. That I was hired to see to it and that they were getting in the way. I advised them to get out of that pass. If they did not, there was no telling what night an Indian outbreak

(Continued on page VII)

THE BY-PRODUCT COKE INDUSTRY

The Development of the Coke Industry—A Description of the Types of Ovens Used and Their Operation—
The Differences in the Yields of the Different Types—The By-Products and Their Importance.

By A. H. VON BAYER, C. E. '00, M. A. S. M. E., M. A. I. M. E.

COKE is the product obtained from the distillation or partial combustion of bituminous coal in ovens or retorts, which constitutes a fuel suitable for the blast furnace or foundry.

Historically, it appears that the Chinese used coke as an article of commerce in 100 B. C. or some two thousand years ago. Then again, it is recorded that during the Middle Ages, it was manufactured for use in the Arts and for domestic purposes.

The earliest record of coking coal in a regular oven is in 1620 when a patent was granted in England to Sir Wm. St. John for making coke in a bee hive form of oven.

In 1700 J. Beeher, a German Chemist, took out a patent to save tar from coking coal, and to utilize it for preserving ropes and wood.

A chemist named Stauff, who lived in the forest near Saarbrücken, Germany, in 1771 treated bituminous coal in ovens on a hill over a burning mine and obtained oil, pitch, coke and soot. The great German writer and thinker, Goethe, paid a visit to Stauff at his home in the forest and bestowed upon him the title of "Kohlenphilosoph" (Coal Philosopher). Goethe describes this visit in his Autobiography in Book 19 as follows:

"Ready and glad to pour his complaints into a human ear, the lean, decrepid little man, with a shoe on one foot and a slipper on the other, and with stockings hanging down and repeatedly pulled up in vain, dragged himself up the mountain to where the pitch house stood which he had built himself, and now with grief saw falling to ruins. Here was found a connected row of ovens in which coal was to be freed from sulphur and made fit to use in the iron works; but, at the same time, they wished also to recover the oil and pitch, and indeed, did not want to lose even the lamp black, so that all failed together on account of the many ends in view."

Later, in 1781, a patent was issued to the Earl of Dundonald of England, for making coke in beehive ovens and also for producing "tar, pitch, essential oils, volatile alkali, mineral salts, etc." This appears to have been one of the early fairly successful attempts at saving the by-products.

In 1792 Wm. Murdock, a Scotchman, who was a mechanical engineer associated with James Watt in steam engine building, was one of the first to experiment successfully with making gas from coal in retorts; and, in 1812 it is recorded that the streets of London were first lighted with gas, presumably an outcome of Murdock's experiments.

In America, we find that the history of coke mak-

ing begins in 1817 when at Plumecock, Fayette County, Pennsylvania, Col. Isaac Meason used coke "made in the ground" in his rolling mill.

This method of manufacture is interesting, antedating as it does the regular beehive method. The coke yard is prepared by leveling a piece of ground and surfacing it with coal dust. The coal to be coked is then arranged in heaps or piles with longitudinal, transverse and vertical flues, sufficient wood being distributed in them to ignite the whole mass. Beginning on a base about 14 feet wide the coal is spread to a depth of 18 inches. On this base the flues are then arranged and further coal piled on top, the flues being made of refuse coke and lump coal covered with billets of wood. The heap is then fired, the kindling wood flues carrying the fire evenly throughout the entire pile. Any point which burns too freely is covered with fine coal dust which partially smothers the uneven combustion. When the burning of the top portion has ceased, water is applied down the vertical flues. This being converted into steam, permeates the entire mass and, if carefully applied, adds but a small percentage of moisture to the coke. This method of making coke required from five to eight days, depending mainly upon the state of the weather.

The first authentic record of the use of ovens for making coke appears in the year 1841 when Provance McCormick, James Campbell and John Taylor formed a partnership for the manufacture and sale of coke made in two ovens on Taylor's farm located in Fayette County, Pennsylvania.

These ovens were built on the same style as the present beehive oven, except that they were all brick or masonry instead of having charging holes, frames and doors of iron as is the practice today, being about 10 feet in diameter and having a capacity of about 80 bushels each.

In the Spring of 1842 enough coke had been made to fill two boats 90 feet long—about 800 bushels each—which were taken down the Youghiogheny, Monongahela and Ohio to Cincinnati where after some weeks, it was disposed of in small lots at about 8 cents per bushel.

From then until 1855 a few ovens were built and some further experiments were made. Records have it that there were 26 coke ovens along the river above Pittsburgh in 1855.

On the completion of the Clinton furnace of Graff, Bennet & Company of Pittsburgh, in 1859, the successful use of coke as a blast furnace fuel was thoroughly demonstrated and 30 ovens were built

at the Fayette coke works. From that time on coke manufacture increased by leaps and bounds in all sections of the country, the output in 1893 reaching a total of 9,500,000 tons.

The first by-product ovens in America were built at Syracuse in 1893 by the Solvay Process Company who were manufacturers of soda ash. In this process, large quantities of ammonia are used and it was to obtain ammonia that they were prompted to build 12 ovens. They were so successful that the Semet-Solvay Company was formed with the object of erecting by-product oven plants, relying at first chiefly on their recovery of the by-products.

About this time, Dr. Schniewind came to America with the license to build Otto-Hoffman ovens and a plant of 60 ovens was built at Johnstown, Pennsylvania, for the Cambria Steel Company and put in operation in 1895. This was the first use made of by-product coke in the blast furnace industry in America.

Since then, various other types of by-product ovens have been introduced both in this country and abroad, all while essentially different in method of construction, striving for the same general results—a good metallurgical coke with the recovery of all the by-products.

The Semet-Solvay ovens are the principal exponent of what is known as the horizontal flue type in contra-distinction to the vertical flue type prominently represented by the Otto-Hoffman, Koppers and others.

In the vertical flue type, the gas is introduced in horizontal flues on each side of the oven at the bottom which extend half way to the other end. The products of combustion ascend through a number of vertical flues which reach the top of the oven where they deliver into another horizontal flue, which reaches the whole length. This connects with a similar set of small flues which deliver the hot gases into a horizontal flue, or combustion chamber at the bottom, like the first, and thence to a regenerator of the familiar Siemens type.

In the horizontal flue oven there are from three to six horizontal flues, one above the other on each side of the oven chamber, extending the full length of the oven, and connected with each other at the ends so as to form a continuous flue for the gas and flame. The travel of the gas is from above downward, that is; through the top flue, then backward through the second, etc., the bottom flues being connected with a passage to the chimney. A small amount of gas is introduced at the ends of the flues along with a sufficient amount of air for its combustion. This air is preheated by a simple arrangement in the bottom of the ovens, and the combustion goes forward continuously without any attention, often for weeks at a time, it being only necessary to see that the proportion of gas and air re-

mains the same and of sufficient quantity to keep up the necessary heat in the ovens.

The waste gases which have a temperature of about 1200° C. after leaving the oven flues are carried under boilers which supply steam for operating the machinery of the plant. These gases go to the stack at a temperature of not much over 200° C. so that from the point of view of heat economies, such an installation is unusually efficient.

The Semet-Solvay type of ovens are usually from 16 to 20 inches wide, 30 to 36 feet long and from 9 to 12 feet in height and will contain from nine to sixteen tons of coal per charge. This charge of coal is coked in about 16 to 20 hours; and when the gases are all driven off, the doors at each end of the ovens are opened and the whole charge pushed out by a powerful pusher or ram into a steel car, in which it is quenched and immediately taken to the furnace bins for use or shipped elsewhere.

As soon as the ram has been withdrawn and the doors are closed, the oven is ready for another charge and practically no heat has been lost, as the quenching is all done on the outside of the oven. The entire process of discharging and recharging an oven can readily be completed in from 12 to 15 minutes.

As the gas which is distilled from the coal leaves the oven, it enters a large flue known as the hydraulic main. This extends the whole length of the battery of ovens and is partially filled or sprayed with water. The gas bubbles through the water or spray and a portion of the tar and ammonia is condensed. From the main, the gas passes to the condensers. These are large vertical cylinders filled with tubes through which cooling water is made to circulate. The gas, passing around these tubes, is cooled and a further portion of the tar and ammonia condenses.

Exhausters occupy the next place in the series of apparatus, their use being to draw the gas from the ovens through the pipes and condensers and to discharge it into the next following apparatus, which is the ammonia washer. In this vessel the final traces of ammonia are removed and the gas is passed into a benzol washer where it is scrubbed with a heavy oil, removing all traces of benzol, the benzol being absorbed by the oil and subsequently recovered by fractional distillation and condensation. The gas thus cooled and washed is free from condensable matter and ready to be used for heating or lighting.

An investigation of the subject will immediately show that the essential distinction between the operation of the retort oven and that of the original beehive is that in the former, the coal is coked without the admission of air by heat applied from the outside, while in the latter, the air is admitted to the oven and the combustion takes place in and immediately over the body of coal. The result is that in one case the hydrocarbons are distilled off with

a certain breaking down and deposition of graphitic carbon on the coke so that a yield of coke greater than the so-called theoretical can be counted upon; while in the other case, most of the hydrocarbons are burned in the oven, some graphitic carbon is deposited and some of the fixed carbon of the coal is burned, resulting in a yield of coke less than the theoretical.

As an illustration of the difference in yield resulting from this difference in method of coking, a good yield of coke from Connellsville coal in the beehive is from 60 to 65 per cent; while in a good retort oven, the customary yield is from 70 to 75 per cent, or an increase of about 15 per cent. This increase reduces proportionately the percentage of ash, phosphorus, etc., remaining in the coke so that the retort oven yields more coke and a purer coke than the beehive from the same coal. This increase of yield varies with the proportion of fixed carbon, ash, etc., in the coal.

The essential difference between beehive and retort oven coke lies in its hardness and shape, caused by the different application of heat in the oven. In the beehive the coal is spread out in a layer 23 to 24 inches thick over a surface of some 12 to 15 feet in diameter. The bottom of the oven having been cooled by the quenching of the previous charge and by contact with the new one, coking begins at the top and extends downward, reaching the bottom in from 40 to 60 hours. The coke has ample opportunity to swell and develop a cellular structure in accordance with the composition of the coal and entirely independent of any attempts at control. The typical form of beehive coke is, therefore, long fingerlike pieces widening toward the bottom of the oven and with an inch or two of spongy coke at each end.

The inability to control the formation of the cells makes it essential that just the right coals are used, or the requisite hard body, resistant alike to pressure and the action of the hot carbonic acid in the blast furnace cannot be obtained.

The fact that coal of the Connellsville district gives just the requisite structure when coked in the beehive oven is the reason for its pre-eminent position as a blast furnace fuel.

In the retort oven, the coal lies in a high, narrow mass 6 to 10 feet in height and from 16 to 22 inches wide. The previous charge having been pushed out rapidly by machinery and quenched outside, the oven is hot when the fresh charge is introduced and the evolution of gases begins immediately from the coal lying in contact with the hot sides.

The flow of gases being from the sides, they meet in the center and rise to the top, where they escape, forming a sort of cleavage plane midway between the two walls. The end of the piece next to the wall is denser and the end next the cleavage plane is more spongy than the main body.

The cellular structure is more compressed than in beehive coke, principally on account of the narrow retort that permits no expansion in the direction of the flow of the gases, and also because the depth of the charge is usually four to six times as great as in the beehive. The cellular structure of retort coke is dependent somewhat on the proportion of the ovens, the temperature, the time of coking, and the kind of coal used.

The ability of the retort oven to coke coals that cannot be used in the beehive is largely due to the more rapid application of the heat, fixing the pitchy or coke making portion of the coal before it has time to escape and the formation of a firm cellular structure by the pressure.

The by-products consist primarily of ammonia, tar, light oil and gas; and in addition to the increased yield of coke, are the sources of profit from the by-product oven which are wholly lost in the ordinary beehive.

Some retort ovens are without the by-product apparatus, and burn the gas to heat the ovens without washing it. These ovens recover no ammonia, light oil or tar, but use the excess gas for raising steam; but the by-products are so easily saved, and the profits therefrom make such an acceptable addition to the profit side of the ledger, that they can hardly be neglected.

The ammonia is a substance given off from the coal in the oven very slowly at first, but as the temperature of the charge rises, the quantity increases; and after some hours, the evolution is quite rapid. As the coking approaches completion, the yield becomes much less and stops altogether although a portion of the nitrogen originally in the coal still remains in the coke. The yield of ammonia varies very much in different coals and depends partly upon the amount of nitrogen and oxygen in the coal. It varies also with the temperature at which the coal is coked.

The ammonia from the ovens is collected in the hydraulic mains, condensers, and scrubbers along with the tar by the cooling and scrubbing of the gas. It occurs in two forms in the liquor; fixed and volatile, the former containing the sulphates, chlorides, cyanides, etc., while the latter contains the carbonates, sulphides and some free ammonia. The bulk of the fixed salts is condensed first and the volatile later. The ammonia liquor is quite weak when it is first drawn from the tar, usually containing from three-fourths to one per cent of ammonia.

The weak liquor may be either converted directly into sulphate and sold as a fertilizer or, by purification and concentration, it may be converted into aqua ammonia or anhydrous ammonia which is used in refrigeration and other apparatus. The yield of ammonia from the bituminous coals from the western part of Pennsylvania is from 16 to 22 pounds sulphate per ton of coal.

Large quantities of tar are used for roofing, paving and as a liquid fuel, and much is distilled and separated into pitch and the various lighter oils which are further treated for the almost endless number of valuable substances which they contain.

Properly developed, its manufacture into the more valuable products should yield very satisfactory profits. Our chemical manufacturers realize this fact and, during the past few years, plants for the distillation of tar are rapidly growing in number and importance.

The rapid increase of by-product ovens and the resulting large amount of tar which is being put on the market has made it necessary to find another outlet for it than the cruder uses. Consequently, the distillation of tar is now becoming a very important industry in this country.

Coal tar is a mixture of approximately one hundred and fifty distinct chemical substances of which nine form the basis of the dye and pharmaceutical industry. These are benzol, toluol, xylol, phenol, naphthalene, anthracene, methylthracene, phenanthrene and carbazol. These constitute from 6% to 12% of the weight of the tar, or from 40-100 to 75-100 of 1% of the coal coked. When separated from coal gas or coal tar, and subjected to the action of acids and alkalis in processes called syntheses, they can be made to yield several thousand chemical products. From these about 900 dyes and possibly 900 pharmaceuticals, perfumes, and flavors have survived in the world's markets and are known as coal tar products. None of them exist in coal tar, in these final forms.

The main products of the distillation of tar are light oil or benzol, creosote or heavy oil, naphthalene, anthracene and pitch.

The light oils obtained from tar constitute only about 5 per cent of the weight of the tar. The greater amount of light oil being obtained directly from the gas by scrubbing and distilling.

Coal tar yields about 25% to 35% creosote oil which is used for the impregnation and preservation of wood. In 1915 about 120,000,000 gallons of creosote oil valued at nearly \$7,000,000 were consumed in the United States. More than half of this was used in the treatment of railroad ties, the remainder principally for paving blocks, piling and structural timber. Two-thirds of this entire consumption was imported, our oven production then being far below our requirements. Since the war this product has been so increased in this country through additional plants that further importation is not essential for our needs.

The heavier oils and soft pitches find ready use as road binders and roofing papers and protective and water-proofing paints. The hard pitch is used chiefly for briquetting finely divided fuels, thus opening up acres of refuse culm banks in eastern Pennsylvania as valuable fuel resources which, un-

til now, had been practically an absolute loss.

The yield and quantity of tar from retort ovens depends on the coal used as well as the temperature at which the distillation takes place. The yield from the coals in western Pennsylvania is from 70 to 100 lbs. or 7 to 10 gallons per ton of coal. The tar produced in by-product coke ovens in the United States in 1918 amounted to a total of 265,000,000 gallons.

As mentioned before, the light oil, or crude benzol, is separated from the gas and recovered by distillation and condensation. It is a clear, colorless liquor, highly volatile, somewhat similar to the naphtha products of petroleum distillation.

It is the principal source of luminosity in the gas, and when removed therefrom, renders it useless for illuminating purposes in a flat burner, but does not materially affect its heating or fuel value. It is used as a substitute for gasoline in internal combustion motors and, on account of its higher explosive properties, it is possible to get from 15% to 20% more mileage from its use than from gasoline. It is also used as a solvent for rubber, in cleansers, as pitch paint thinner, for gas enrichment and various other purposes.

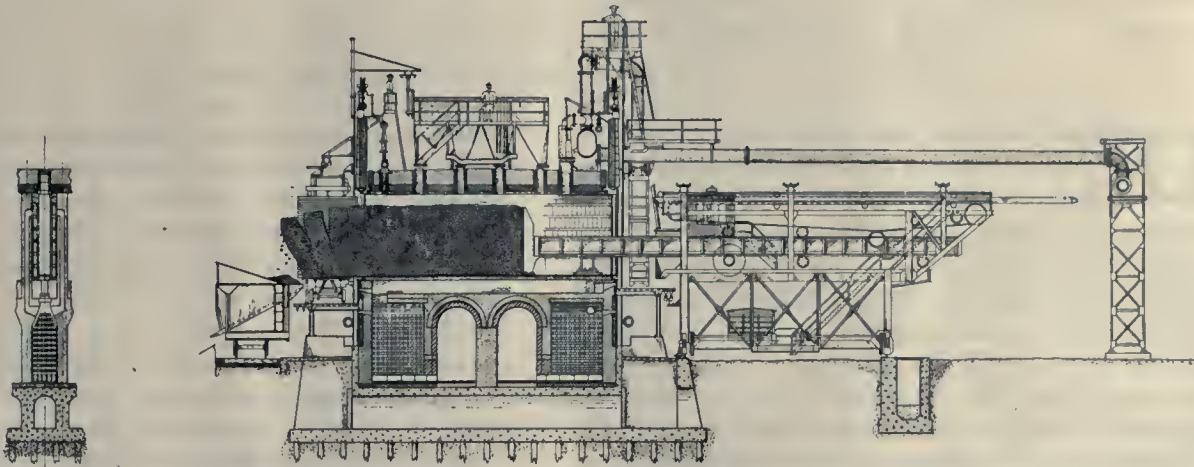
It is the source of aniline dyes, certain nitro compounds used in explosives and various chemicals, medicines and drugs. Carbolic acid and picric acid are obtained also from benzol, being manufactured synthetically at a number of plants.

The yield of benzol from a ton of coal varies, as do the other by-products. Good practice will obtain a yield of from 2 1-2 to 3 1-2 gallons per ton from the western Pennsylvania coals.

The gas that is obtained from retort ovens is a by-product the value of which varies greatly with the locality in which the ovens are situated. When the ovens are at the coal mine, the gas is frequently valuable only for steam raising purposes and, at the usual prices of coal at the mines, would be worth but a very few cents per thousand feet. An intermediate condition would be when the ovens are adjacent to an iron or steel works where the gas could be used for heating furnaces, soaking pits, etc., where it would supplant producer gas, being much more conveniently applied and easily freed from all impurities. The most favorable location for obtaining a good value for oven gas are those adjacent to large towns where there is a demand for illuminating or fuel gas.

Coke oven gas from properly managed retort ovens is approximately the same article as that from the retorts of a gas house, the processes of manufacture being similar. Its quantity and quality vary with the coal used and the temperature of distillation; but, made from good gas coal, it is well suited for illuminating purposes after being passed through the ordinary lime boxes to remove the sulphur, etc.

SEMET-SOLVAY STANDARD REGENERATOR COKE OVEN



If, from the nature of the coal, the illuminating power of the gas is low, it can either be enriched by any of the well known methods, or burned with incandescient burners, or used as a fuel gas, as the lack of illuminants will not appreciably affect its fuel value.

To sum up briefly then, it will be seen that the coking of coal in the by-product oven differs in the results obtained in the following particulars from the same operation in the beehive oven:

From the beehive oven we obtain coke of an excellent quality if the coal used is just adapted to the purpose, but the yield is from 5% to 20% lower than the analysis of the coal shows should be obtained. In addition to the coke, there is a great deal of smoke, which by those living near the ovens, is hardly looked upon as a valuable product.

From the by-product retort oven we have coke again, and always more than the analysis of the coal indicates. The quality is equal if not better than the beehive coke; and moreover, a good metallurgical coke can be made from many coals that are worthless in the beehive oven.

In addition to the increased yield of coke, we have from a ton of coal from 16 to 22 lbs. of ammonia; from 70 to 100 lbs. of tar; from 2 1-2 to 3 1-2 gallons of benzol; from 3,000 to 8,000 cubic feet of surplus gas.

The manufacture of coke is almost the only metallurgical operation that we Americans continue in a measure to conduct after the manner of our ancestors of a century ago.

The year 1915 shows a grand total of 41,500,000 tons of coke produced in this country for which was

used almost 61,000,000 tons of coal. Of this coke about 66% was manufactured in the beehive oven, only 34% in the modern by-product retort oven.

Since then, owing to the enormous demands for war materials, a great number of new by-product oven plants have been built, so that during 1919 about 52% or 26,000,000 tons of our coke supply came from the modern oven plant.

A recent magazine article states that for every ton of coke made in a by-product oven, there is saved in fuel alone the equivalent of 825 pounds of coal. For every ton of coke made in a by-product oven and applied to use in a blast furnace, there is a direct saving when compared with beehive coke of 200 pounds in the oven and 282 pounds in the blast furnace. When a house holder burns one ton of good bituminous coal in a heating furnace or a kitchen range, he has sacrificed something like 11,000 cubic feet of gas; nine gallons of tar; twenty-five pounds of ammonium sulphate; 2.08 gallons of pure benzol and 0.56 gallons of pure toluol.

That in our industrial life the use of coal derivatives is only commencing to be felt. The rubber industry depends upon these products for solvents, compounding ingredients and softeners. Practically all types of paint now use a derivative of coal. Printing inks, shoe polishes, brake linings, dry cleaners, perfumes, explosives, linoleums, glues, pastes and photographic developers contain coal products as basic ingredients. The paper industry, the soap business and shoe manufacturing would be hard hit were it not for the offspring of Old King Coal. The electrical industry would likewise be cut off from

(Continued on page 64)

THE OPPORTUNITY OF THE ENGINEER IN WATER POWER DEVELOPMENT

Some Super-Power Proposals—the Profitable Moderate Enterprise—Selection of Site—Planning and Layout of Station—Some Important Details.

By W. B. POWELL, M. E. STEVENS '92

Mem. A. S. M. E., Pres. Eng. Soc. of Buffalo, Consulting Engineer, Buffalo, N. Y.

DURING the past five years, public attention has been directed more forcefully than ever before to the necessity for the development of all of our available water powers. The world war with its consequent demands for excess production in every direction, and its disruption of industrial labor, focused attention on our present dependence on coal for a fuel, at the same time revealing in no uncertain way the inadequacy of our methods, equipment, and transportation to meet such critical demands; hence followed makeshift adjustments as to price, wage and working conditions so as to procure the coal which we had to have to complete our war program. But with the cessation of the war crisis there has ensued a period of readjustment that has resulted to-day in a far reaching coal famine with prices soaring to prohibitive heights in the face of a general tendency for a lowering of commodity prices. It is not surprising therefore that the press and the public have come to a realization of the need for an improvement in our methods of producing power, and a variety of plans are offered to meet this acute need for the future.

But no matter how pretentious such proposals may be, it is significant that in every instance, one of the principal elements involved is the development of waterpower. For example, the most ambitious plan that has so far been projected is for a super-power trunk line along the Atlantic Seaboard which contemplates linking the water powers of New England and northern New York with the production of power in large units in the coal fields where transportation can be eliminated and mammoth economies can be realized.

Or in another case, the proposed St. Lawrence Ship Canal is being fostered by our Canadian neighbors, not so much for its possible value as a transportation route (although most of the emphasis has been placed on that aspect), as for the 4,000,000 horsepower of electric energy which can be derived from it.

Perhaps the most notable example of this change in the mental attitude of the public is to be found in relation to the further development of power at Niagara Falls. Before the war, any person who had the temerity to suggest the diversion of any more water from Niagara for power purposes was hooted away without ceremony as a desecrator of Nature's beauty; but now it is possible to secure

respectful hearing for the suggestion that 40% of the present flow could be utilized without seriously affecting the natural spectacle, while at the same time definitely preserving the crest of the Horse-Shoe Fall which is now cutting back at a very rapid rate into a narrow channel.

But, while the popular mind is thinking of waterpower mostly in terms of these large advertised projects, the fact remains that throughout our State there exist numberless small waterpowers which could be profitably developed, while in Canada the resources of this sort are practically unlimited. It is these smaller enterprises which offer attraction to the private owner, for naturally investment capital is interested in participating in this new phase of our national growth. So the engineer to-day enjoys an exceptional chance to point the way toward profitable opportunities. Particularly is this true because the modern hydro-electric power station shows so little evidence to the casual visitor of the vast amount of engineering skill, knowledge, and conception necessary to its successful completion. There is so little of the spectacular in a placid lake of water impounded behind an apparently small dam with a modest powerhouse tucked down in a secluded nook in which a few generators are silently whirling under the eye of only one or two attendants, that it may be worth while to analyze the various steps which the engineer has followed to bring this useful adjunct of civilization to its present perfection.

The selection of a site is the most important phase of the project, and the one in which the engineer can display the greatest amount of clever analysis. There must be a large area of water shed, with good annual rainfall, substantial fall within reasonably short distance, large areas for impounding flood waters, with good foundation material for a small dam to hold them, low value of land involved for acquisition, and adequate market for power within a moderate distance. All these elements should be considered and included if possible in an unostentatious preliminary investigation, not a full survey. This is important because the next step, the securing of options on the property should be accomplished before the owners inflate their prices in prospect of fabulous profits from the development. Many a promising project has been abandoned because the engineer would not trust his observations

on preliminary view and made the mistake of running his survey before optioning the property. Once this step has been taken, preferably by some keen real estate operator, the engineer can then make a complete survey of the site, from which he can determine a safe estimate of the cost of its development.

He figures the area of the watershed, finding the number of square miles which will supply water to the proposition. From rainfall data, he is able to determine and plot a curve showing the number of cubic feet of water per second which will be available for each month of the year. The investigations of the river valley determine the feasibility of storage reservoirs to hold back the spring floods, so that the water may be used during low water months.

After the foregoing data are collected, the next step is to render a report covering in detail the total cost of development, and the amount of power which can be expected, the possibilities of disposing of the power and the returns that should be obtained, less all expenditures covering the operation of the plant, taxes, insurance, depreciation, etc.

If this report is favorably received and the Engineer is then requested to prepare working plans on the complete project, he proceeds to obtain careful surveys of the dam, storage and power station sites, on which to base the design of the various features of the work.

The dam and dykes are carefully designed to be safe against high water conditions with suitable waste gates for excess flow and head gates through which the water is to be furnished to the station. In the forebay design not only should ample head gates and water racks be provided, but great care should be taken that as little head as possible be sacrificed in handling the water. In high water propositions, the use of penstock is employed to convey the water from the dam to the water wheels.

The Engineer has many things to consider in the penstock lay-out. The size of the penstock is determined by the amount of water to be conveyed, and the speed which will be used, losing as little head as possible. Then vent pipes are designed, supporting saddles for the pipe line located, expansion joints provided, and usually a standpipe is found to be necessary. In addition to the head gates used at the entrance of the penstock from the forebay, especially in cases where a long penstock line is used, a large hydraulic valve is located in it, usually in the station, to permit the station operator to stop the flow of water without closing the head gates. Provision is also made to drain the penstock. In place of the standpipe, and many times in addition to it, a relief valve is located at the lower end of the penstock line, to reduce the effect of water hammer on the penstock, should wheels be closed to rapidly.

An open canal is usually employed only under low heads, which type of design permits the water racks to be located at the station. Gates are provided at the entrance of the canal and head gates are located at the flume entrance, back of the water racks.

Within the station the most important consideration is the selection of the type of water wheel, in which matter the Engineer must be guided largely by experience. When this point is decided he proceeds to design the power station. The location of the water wheels and generators is carefully considered, and when the lay-out is finally decided upon, the flumes, draft tubes, etc., are detailed. Suitable flume drains are provided, conduits planned to extend from the generator to the switch board, and governors located at points as convenient as possible for the station operator. Exciters are laid out, and conduits planned to take care of the wires for this part of the installation. Frequently a crane is included to handle the equipment readily, and in most cases sufficient room is planned in the station to dismantle one unit in case of a breakdown.

In case the power developed is to be transformed at the station, a study has to be made of the various types of transformers, and after a proper selection, provision is made for their installation.

If the station is located in a cold climate, a suitable heating plant is needed to heat the building during cold weather, in case the station should be shut down. Under ordinary conditions, a sufficient amount of heat is generated by the machines when they are operating.

A lighting system is planned to provide suitable lights in all parts of the plant, special care being exercised to install an ample number of trouble sockets so that light may be obtained at remote points for inspection purposes.

Roadways leading to the plant must be located so that the heavy trucking necessary to readily install or remove any of the apparatus may be done with as little effort as possible.

Finally complete specifications describing the various materials to be employed and their combination and assembly are prepared by the Engineer so that the prospective contractors may be able to make accurate bids covering work to be done.

After the contracts for the construction work have been awarded, the Engineer furnishes all lines and levels necessary and thoroughly inspects the work as it is being completed, following all details of construction very closely.

Throughout the designing of the project, the Engineer must consider the efficiency and economical design of each and every item which will combine to make the complete development. In no case should an unreasonable loss of head be sacrificed without thoroughly investigating the advisability

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COLLEGE NOTES

Cross Country Intercollegiate Champions.

Cornell won its sixteenth Intercollegiate Championship at New Haven on Saturday, November 20. The Red and White runners took first place from Princeton by a single point. The final score was 55 to 56, with M. I. T. in third place with 90 points. The surprise of the meet was furnished by Romig of Penn State who took the individual honors by leading the field home in the good time of 33 minutes, one second; breaking the record for the Yale course. Higgins of Columbia, who was scheduled to win, placed second; Rogers of Princeton, third; McDermott of Cornell, fourth; and McMahon of M. I. T., fifth.

The Red and White harriers won the Championship through superior team work, the whole team, consisting of seven men, placing in the first 22 out of 68 entered. Of these seven men the five to count in the scoring finished in fourth, eighth, tenth, fifteenth and eighteenth places; T. C. McDermott, C. E. '21, N. P. Brown, R. E. Brown, C. G. Irish, and H. V. Bonsal, C. E. '23, taking these positions, respectively; while Captain Dickinson and A. L. Lentz came in together in twenty-first and twenty-second places. It was not expected that the Princeton harriers would give the Ithacans as much competition as they did. From the start, however, it was clearly apparent that the fight for the championship was between these two teams, with the members of the two squads passing and repassing each other during the entire distance.

The victory was especially pleasing to Coach "Jack" Moakley, mentor of the Cornell runners. The fact that the team was able to take first place in a strong field of twelve teams proves to "Jack" that he will be taking a team of representative American runners to England, when the Red and White Team journeys across the Atlantic during the

Christmas recess to run against a combined Oxford-Cambridge cross country team. The men who will make the trip to England have not been decided upon as yet and it is not likely that they will be definitely known until the day of departure, since Coach Moakley is expecting to hold trials up until the last minute. It is reasonably certain, however, that the men who finished among the leaders in the Championship race will go to England.

With the College year scarcely begun, a Cornell Varsity Team has already captured its first championship. This is an excellent way of introducing all the other championships which will undoubtedly follow.

On Saturday, November 13, a crowd of fourteen thousand saw the Cornell Cornell 34 Columbia 7. Football Team completely overpower Columbia by a score of 34 to 7. The "Big Red Team," playing the best football it has this season, showed itself superior to Coach O'Neill's team in every department of the game. One of the big improvements in the playing of the Varsity was the interference provided the backfield man carrying the ball. Mayer, making use of this wonderful interference, proved himself the individual backfield star, scoring four of the five touchdowns. Carey, who started the season at quarter but who now plays fullback, put the pigskin across the line for the other touchdown. Appelbaum starred for the Morning-siders by scoring their only touchdown. The Blue and White line, rated as stronger and heavier than Cornell's did not live up to expectations, and was broken by our hard-charging Varsity with consistency. Coach Dobie had his forwards use but a limited variety of plays, of which the straight line plunge, the fake forward pass and the end run were the most prominent. The fake forward pass worked time and again due to the splendid interference

given the man with the ball. Although the team did not use many different plays during the game the plays that were used were well selected and were executed without a slip.

The game, combined with Alumni Day, drew one of the largest crowds that ever witnessed a football contest on Schoellkopf Field. Over fourteen thousand watched the vain struggle of the Blue and White. Special wooden stands were erected on the west side of the field in order to handle the large crowd. Cornell's budding Cheering Section occupied these stands. More than three hundred supporters of the Blue and White arrived by motor truck, automobile and special train. Next year, Cornell plays Columbia in New York City and the majority of the Ithaca students will journey there in order to help the Big Red Team repeat its performance of 1920 against Columbia.

On Thanksgiving Day Cornell
Pennsylvania 28 went down to defeat before Penn-
Cornell 0. sylvania by a score of 28 to 0.

The Varsity was outplayed and out-generated during the whole contest. Not once did the Big Red Team threaten Penn's goal. Cornell put up a desperate fight, but Penn's successful use of the forward pass easily proved superior to the straight football of the Cornell team. Franklin Field was in no condition for an ideal football game. Throughout the entire game, a dismal and drenching downpour prevailed adding to the discomfort of both the players and the spectators. The game was stopped several times in order to give the players an opportunity to wipe the mud from their faces.

The Varsity played a hard, desperate game in the face of a growing defeat. The Penn line was both impregnable and invulnerable and repulsed the Cornell attack with ease. The first score came when Wray threw a pass to Strauss, who tore off a 40-yard run for a touchdown. After rushing the ball down from midfield Penn gained its second touchdown by passing the ball over the line after Cornell had held Penn on the one yard line for three successive downs. Rex Wray, the 139-pound quarterback of the Penn team, easily proved himself the star of the game. He broke away consistently for long gains and his wonderful generalship was a fine exhibition of football. Whitehill, Miller, Strauss and Ward also played a brilliant game for Penn. For Cornell, Kaw, Mayer, Carey and Hoff played well but none of them were able to get started on the brilliant style of play that characterized all their playing in Ithaca. Carey was up to his usual form in punting but poor defense on the part of the Ithacans let the Penn forwards get through to block or force him to hurry his kicks. Kaw and Mayer each made some long 25-yard runs but otherwise their

efforts against the Penn line were of no avail. Due to the slippery condition of the ball, numerous fumbles were made on both sides. Two forward passes were tried by Cornell, and both were intercepted. Two of Penn's touchdowns came as a result of completed forward passes which were executed at strategic moments. The defeat of the Varsity was a big disappointment to the large crowd of alumni and students who had attended to watch what everyone thought was to be the defeat of our traditional rival. And also, the decisive result of the contest came as a big surprise to the Penn rooters who had little expected victory at all.

When Coach Dobie spoke at the Athletic Rally in Bailey Hall at the beginning of the season he said that this year the Cornell team would not have the slightest chance of defeating a strong, representative Eastern eleven. Although big scores have been rolled up against comparatively weak teams his prophecy seems to have come true for the only two defeats of the season came at the hands of "strong, representative, Eastern elevens."

With the playing of their last game on
Freshman Saturday, November 20, on Schoellkopf
Football. Field, when they were defeated by the

Penn Frosh, the Cornell Freshman football team ended its season with two victories and two defeats to its credit. The four teams on the Frosh schedule were: Mansfield on October 23, Wyoming Seminary on October 30, Columbia Frosh at New York on November 13, and the Penn yearlings on November 20. The Cornell Freshman lost their first and last games and scored a total of 78 points during the season to their opponents' 26. They defeated the previously unbeaten Wyoming team by a score of 24 to 6 and two weeks later journeyed to New York and swamped the Columbia youngsters to the tune of 47 to 0. The defeat at the hands of the Penn Frosh came as a distinct surprise, for everyone expected the Cornell Freshmen to clean up after their brilliant showing against the supposedly powerful Columbia Freshman team. After meeting Penn's offensive successfully for the first half of the game the Frosh eased up and let the Penn team get away for two touchdowns as a result of forward passes in the last half of the game. After Penn's second score, Cornell, showing a powerful attack and a grim determination to win, opened up their drive and marched completely down the field for a touchdown. Their second try for a touchdown came too late, with the result that the laurels once more went to Penn. On the whole, however, the season has been very successful, in that it has brought to light many excellent possibilities for Varsity candidacy next year which fact will be of great assistance to Coach Dobie when he starts making his preparations for the season of 1921.

Dean Kimball Elected Vice-President of Federated Engineering Societies.

Dean D. S. Kimball of the Cornell College of Engineering was elected as one of the Vice-Presidents of the Federated American Engineering Societies at the first meeting of the Council of that body held in Washington on Saturday, November 20. Dean Kimball attended the meeting as a representative of the American Society of Mechanical Engineers and made the nominating address for Herbert Hoover who was elected President of the newly-formed society. The other vice-presidents of the society are Calvert Townley, vice-president of the Westinghouse Electric Manufacturing Company; J. Parke Channing, president of the Miami Copper Company, and William E. Rolfe, president of the Associated Engineering Society of St. Louis. Under the leadership of these executives the new federation is expected to be effective in making the talent and experience of engineers available in the public service.

With the election of Dexter S. Kimball to the position of vice-president of the Federated American Engineering Societies, Cornell scores no mean triumph. The dean of our newly-combined engineering college has added greatly to his laurels and Cornell reflects the honor. The position carries with it about the highest honor that can be conferred in the engineering world, and Cornell is proud that it is to one of her faculty that it goes. No other university is represented on the executive body of the society which makes the distinction due Dean Kimball and Cornell, all the more unique.

Phi Kappa Phi Elections.

Fifty-four new members were elected to the Cornell Chapter of Phi Kappa Phi, the new senior honorary society. The Cornell Chapter which was installed last spring is the twenty-fourth chapter of the society. The aims and objects of the Society are to further scholarship in the minds of college students; to hold fast to the original purposes for which institutions of learning were founded and to stimulate achievement by the prize of membership. Two members of the faculty and four seniors were elected from the College of Civil Engineering. Those elected were: Professor Barnes, head of the Department of Railroad Engineering; Professor Scofield, head of the Department of Materials of Construction; Margaret George Arronet, '21; Donald Griswold Coekeroft, '21; Harold Ingersoll Hettinger, '21, and Lawrence Raymond Wells, '21.

New York State Older Boys' Conference.

The Older Boys, representing the Y. M. C. A. from every city in the state, assembled here on Friday, November 26, to hold what resulted in being one of the most successful sessions of its history. Fully 1,700 High

School boys were accommodated and entertained by residents of the city and students in the university.

The central theme in the conference was "The Christian Program." Many excellent addresses on this subject were given to the various groups of boys gathered in the lecture rooms of Rockefeller, Goldwin Smith, and other nearby University buildings. The Cornell University Christian Association with the aid of local religious organizations played the part of host with excellent success.

One of the interesting features of this monstrous get-together was the participation of a majority of the boys in a titanic athletic exhibition staged on the floor of the Drill Hall. Strong competition was the key-note to every contest, the winners being duly rewarded with prizes.

Excursions around the campus were organized on Sunday, giving the visitors an opportunity of seeing the natural beauty of our campus. Every effort was made to point out the advantages of Cornell to the visiting delegates, who for the most part, were Juniors or Seniors in High School.

Campus Club Gives Faculty Party.

In attempting to foster a more intimate relation between the members of the University staff, the Campus Club tendered the faculty and their families a huge party in the New Drill Hall on Friday, November 19. A crowd of fifteen hundred was present including about one hundred and fifty youngsters, familiarly known as the "campus kids." The party started with a buffet dinner at 6 o'clock. The entertaining features began with group singing, followed by some undergraduate stunts and a play "Lonesomelike," presented by the Cornell Dramatic Club. The Campus Club carried its unprecedented feat of entertaining the faculty to a successful conclusion, in spite of some discouragement. The presiding genius was Mrs. A. W. Smith, president of the club, who conceived the idea of a great faculty party, and then perfected the organization that put it through. It is hoped that the Campus Club will make the faculty party an annual custom for it is an institution that fills a sorely felt need—that of bringing together in social intercourse the hundreds of workers engaged in the common purpose of furthering the interests of education.

Meeting of Cornell Association of Civil Engineers.

A very spirited and enthusiastic crowd of embryonic Civil Engineers turned out to the second meeting of the Cornell Association of Civil Engineers which was held in the Coffee House at Barnes Hall on Friday night, December 3. The Coffee House is located in the basement of Barnes Hall and was opened at the beginning of this term in order to increase the

democratic spirit at Cornell by providing a place where the men of the University could gather together on various occasions and discuss things informally. The program of the evening called for a speech by Dean Haskell, several undergraduate stunts, a speech by Professor George and the transaction of the Association's business. Dean Haskell and Professor George both told of ways in which the College of Civil Engineering used to win all its intercollege trophies in the old days. The Dean commented on the fact that no intercollege trophy has been won since 1912. He expressed the hope that he would have the honor of hanging another trophy in our library this year, and judging by the discussion of college athletics which followed, we believe he will have that honor. F. O. Schreiner, '22, was elected undergraduate athletic director to succeed R. Anderson, '22, who resigned because he lacked the time necessary to properly attend to the job. After the subject of college athletics had been thrashed out a very spirited discussion of the honor system, as now supposed to exist, took place. The students want an honor system, and they want an honor system that has for its main purpose, not the infliction of punishment to those guilty, but rather the raising of the standard of honor of the whole college. Action was taken along these lines. A motion was passed to the effect that all students in the college will be required to sign a pledge on their exams stating that they have not cribbed. Obviously, this is a step in the right direction, and judging by the sentiment as expressed in the meeting, the students are determined to settle the question of the honor system once and for all this year. Plans were made at the meeting for the holding of a mass meeting within a few weeks, which every student in the college will be required to attend. After the long discussion on the honor system the meeting adjourned to the refreshment room, where cider and doughnuts were served. Here the committee on college athletics met and decided on their program for the year—the program which we all hope will give the Dean the honor of placing another trophy in our library.

Honorary Societies The Student Council and the
Ask Appointment of A. W. Smith '78
As President. Honorary Societies have adopted a resolution requesting the appointment of Acting-President A. W. Smith, '78, as President of Cornell

University until the Board of Trustees appoints his successor. The resolution was submitted to the Board on November 16, and was signed by the Student Council, Sphinx Head, Quill and Dagger, and Aleph Samaeh. The resolution states that in the opinion of those societies, Acting-President Smith "during the brief period that he has been Acting-President of Cornell University has thoroughly won

the affection, confidence and respect of all the undergraduates and has been instrumental in creating a fine spirit of unity, loyalty and devotion to the University * * * and the interests of the University would be best served, and the powers for good would be increased, if Albert William Smith were made President of Cornell University, to serve until the selection and installation of his successor."

A great deal of interest in the
Inter-fraternity inter-fraternity games is being
Basketball. shown this year. Five leagues, each composed of eight fraternities or clubs, have been formed to compete for the large silver trophy donated by the Treman & King Company of this city. Individual prizes for members of the winning team are also to be awarded.

CORNELL SOCIETY OF CIVIL ENGINEERS

Meeting of the Cornell Society of Civil Engineers, October 19, 1920, at 8:30 P. M., held at the Cornell Club, 30 West 44th Street.

The following officers were elected for the year 1920-1921: President, Ira W. McConnell, C. E. '97; First Vice-President, J. Wright Taussig, C. E. '08; Second Vice-President, Prof. Henry N. Ogden, C. E. '98; Recording Secretary, Earl W. Hall, C. E. '14; Corresponding Secretary and Treasurer, Carroll R. Harding, C. E. '10.

It was then announced that Dean-elect Dexter S. Kimball, of the College of Engineering, Cornell University, had been unanimously elected an Honorary Member of the Society.

Amendments to the Constitution were passed by unanimous vote, changing the name to the Cornell Society of Engineers.

Those eligible for membership under the new constitution are: "Persons who have been members of the Engineering Colleges of Cornell University as students or teachers, for a period of one year or longer, are eligible as Resident or non-Resident members, and shall become such upon signing the Constitution and payment of dues. Forms for the purpose of subscribing to the Constitution shall be prescribed by the Executive Committee. The Resident Members shall be those who have their residence or place of business within a radius of fifty (50) miles of City Hall, New York. The non-Resident Members shall be those whose residence and place of business are at a greater distance."

Briefly, the history of the Society and the steps leading up to the important amendments passed on the 19th of October, 1920, is as follows:

The Cornell Society of Civil Engineers was organized in 1905, its object being to promote the

welfare of the College of Engineering of Cornell University, its graduates and former students, and to establish a closer relationship between the College and its Alumni.

It is believed that the objects have been attained. The Society grew rapidly in membership to the present number of 1015, about one-third of which are residents of the district situated within fifty miles of City Hall, New York; two-thirds being non-Resident members. Important relations have been established between the Society and the Faculty at Cornell, which have resulted in many cases, to the mutual benefit of the Alumni and the College.

An Employment Committee has been active ever since the founding of the Society, and many of the alumni have been helped to secure positions.

In 1919, shortly after it was learned that the combination of the Engineering Colleges of Cornell University was under consideration, the Executive Committee of the Cornell Society of Civil Engineers began to consider the best way to enlarge the Society, making it applicable to all Cornell Engineers. The Mechanical Engineers, Electrical Engineers and Architects were invited to attend two annual banquets and several other meetings, and influential Sibley graduates cooperated with fine spirit towards making these joint meetings a success. The large number of Sibley men who came to these meetings convinced the officers of the Cornell Society that the time had come to propose the necessary amendments to the Constitution. They were drafted and presented at the Spring Meeting on April 9, 1920, and were brought up for final vote in accordance with the terms of the Constitution at the next meeting on October 19, 1920, when they were carried unanimously. The success of the amendments was given lengthy applause which indicates that our old members will take great pleasure in welcoming the Sibley men into the Society.

After the adoption of the amendments, Dean-elect Dexter S. Kimball gave a heart to heart talk about the affairs at Cornell University. Dean-elect Kimball's address impressed those present with the great opportunity which is afforded by our Society for keeping in touch with things "on the hill."

A very interesting address was then given by Mr. Clifford M. Holland, Chief Engineer of the Bridge and Tunnel Commissions of New York and New Jersey. His talk was illustrated by lantern slides and he showed in a clear and interesting way the manner in which the difficult problems of ventilation and construction have been solved.

Meeting adjourned at 10:30 P. M.

THE BY-PRODUCT COKE INDUSTRY

(Continued from page 57)

its chief source of insulating material, while the doctors of the country and the druggists who supply them would be up against it for a sufficient supply of phenol from which to get common drugs that are in everyday use.

The losses which might have been avoided in the more efficient method has been figured in millions of dollars, and the economic loss which future generations will feel through our past wastefulness of coal supply is appalling.

We should, therefore, introduce and urge whenever possible the manufacture of coke in the by-product retort oven knowing that it is not unworthy to be linked in the chain of iron and steel manufacture of our most up-to-date modern industries.

Returning for a moment to the early notes under the historical matter, the comments of Goethe are as true today as they were a century ago. One passage of the account of his visit to Stauff in particular being deserving of the closest attention, namely: the statement that "all failed together on account of the many ends in view." In that, the keen eye of the visitor summed up what has been the greatest obstacle to the progress of the industry of coal distillation ever since the days of Stauff.

It produces not only one article or one type of article alone, but four or five all radically different one from the other—different in their uses, and disposed of in different channels.

The relative quantities of the by-products from the manufacture of coke cannot be varied to any great extent and, in most cases, the demand for coke, the main product, absolutely governs the output of the others. Continuous operation is essential to profits, hence a continuous market for the by-products as well as the main product must be secured. Where these requisites have been overlooked or minimized, embarrassment or disaster has not been slow to follow, and the recognition of these difficulties is one of the chief reasons for the seemingly slow progress the by-product oven has made in this and other countries.

In this paper an attempt has been made to summarize outstanding points in the history of coke making and to bring out in non-technical language interesting facts in connection with the by-product coke industry. Many sources of information have been drawn upon in the preparation of this paper; especially acknowledgment being due Mr. W. H. Blauvelt and Mr. H. W. Jordan of the Semet-Solvay Company, Mr. W. H. Childs of The Barrett Company, and Technical Papers issued by the Department of the Interior.

ALUMNI NOTES

'78 M. C. E. '79. Frank E. Bissell is Chief Engineer for the A. S. Hecker Company, General Contractors, Cleveland, Ohio. He lives at 10515 Wilbur Ave.

'91. James W. Beardsley is chairman of the Highway Commission of the Republic of Panama. His address is Hotel Tivola, Ancon, Canal Zone.

'92. Capt. Robert S. Dole has recently been discharged from the army, and has been retained to make an examination of utilities and other properties in Arizona.

'93. Robert H. Jacobs has been elected President of the New York Chapter of the American Association of Engineers. His address is 55 E. 65th St., New York City.

'93, M. C. E. '20. Henry R. Lordly, Consulting Engineer, Montreal, P. Q., Canada, has been elected a member of the American Society of Civil Engineers.

'95. Charles H. Kendall, who is Assistant State Highway Engineer of Texas, has changed his address to 308 West Fifteenth St., Austin, Texas.

'95. Kennerley Robey is a Consulting Engineer and Geologist and his home address is 1420 Boulevard, Fort Worth, Texas.

'98. James P. Whiskeman is an Engineer and Architect with his office at 153 East 40th St., New York City. His home address is 3343 Sedgwick

'02. Charles H. Snyder has been appointed City Engineer of Oswego, N. Y., with offices in the City Hall. His home address is 170 West Fourth St. Ave., New York City.

'03. Frederiek W. Fisher, Adjuster, Employment and Safety Manager for the Rochester Gas and Electric Corporation, Rochester, N. Y., has been transferred from Associate Member to Member of the American Society of Civil Engineers.

'03. Arthur R. Keller, who is Civil Engineer in the University of Hawaii, is now residing at 2456 Oahu Ave., Honolulu, T. H.

'04. Robert C. Dennett, who is with the National Board of Fire Underwriters, 76 William Street, New York City, has changed his home address to 76 South Grove Street, Freeport, N. Y.

'07. Chester G. Wigley, Consulting Engineer with Clyde Potts, 30 Church Street, New York City, has been transferred from Associate Member to Member of the American Society of Civil Engineers.

'08. M. Z. Bair is Chief Engineer of the State Board of Health of Arkansas and his home address is 1106 Center Street, Little Rock, Arkansas.

'08. Harry Kenoe has been appointed Commissioner of Works at Oswego, N. Y.

'09. Frederic J. Biele is a Sales Engineer at 152 Chambers Street, New York City.

'09. A. Clinton Decker is Sanitary Engineer for

the Tennessee Coal and Iron Company, Birmingham, Alabama. His home address is 759 Parkway, Fairfield, Ala.

'09. Robert M. De Garmo is an Assistant Engineer on the F. E. C. Railway, at Marathon, Fla. He was recently elected a member of the American Association of Engineers.

'09. John Dubuis is Assistant Professor of Civil Engineering at Oregon State College. His address is 3045 Corvallis, Ore.

'09. William G. Gridley is Civil Engineer for the Third Field District, Construction Service, Quartermaster Corps, U. S. Army, at Fort Mason, San Francisco, California. He is Supervising Engineer on the construction of balloon fields and hangars at Fort Barry and Fort Winfield Scott. His address is 1030 Post Street, San Francisco.

'10. Milton W. Brower is with the Electric Bond and Share Company, 71 Broadway, New York City. His home address is 64 Walthery Avenue, Ridgewood, New Jersey.

'10. Thomas Dransfield, jr., is an engineer in the structural division with Stone and Webster, Inc., 147 Milk Street, Boston, Mass. He lives at 12 Russell Street, Malden, Mass.

'10. A son, Arthur Edward, was born to Mr. and Mrs. Glenn Woodruff of Bethlehem, Pa., on Sunday, November 14, 1920. Mr. Woodruff who saw service in France with the 32nd Engineer Corps as a 1st Lieutenant is now Assistant to the Bridge Engineer of the Lehigh Valley Railroad at Bethlehem.

'11, M. C. E. '12. Teh Tsing Lee is now in charge of the Design and Drawing Office of the Works Department of the Chili River Commission at Tientsin, China.

'11. W. Mitchell Priece is president and general manager of the Priece Construction Company, 210 Maryland Trust Building, Baltimore, Maryland. He lives at 2703 Roslyn Avenue, Baltimore, Md.

'12. Kwang Yi Char has resigned from his position with the Chuehow-Chinehow Railway and entered the banking business at his old home, Shanghai, China. His home address is 7 Jessfield Road.

'12 Walter G. Distler, who is manager of the Baltimore office of the George A. Fuller Company, gives his address as 2905 North Calvert Street.

'12. Horace C. (Hap) Flanigan was married on the twenty-third of October to Aimee Ruth Magnus, daughter of Mrs. J. William Loeb of Chicago, Ill. Mr. and Mrs. Flanigan will be at home after December first at 116 East Fifty-third Street, New York City.

'13. Wallace D. DuPre is manager of E. F. Bell's Ford Agency, Spartanburg, S. C. His home address is 233 North Church Street.

'14. Paul L. Heslop is at present engaged in the design of a powerhouse and multiple-arch dam for Grants Pass Irrigation District, Grants Pass, Ore.

'14. Charles L. Maas is Production Engineer with the United Gas Improvement Company, Broad & Arch Streets, Philadelphia, Pa. He is a member of the Engineers Club of Baltimore. His home address is 5848 Florence Avenue, Philadelphia, Pa.

'14. George L. Nickerson is Assistant Engineer with the New York State Highway Commission and his business address is Box 104, Poughkeepsie, N. Y. His home address is Box 262, Middletown, N. Y.

'14. James W. Routh, Director and Chief Engineer of the Bureau of Municipal Research, Rochester, N. Y., has been transferred from Associate Member to Member of the American Society of Civil Engineers.

'14. Charles A. Write has changed his address to 7 Ashton Place, Cambridge, Mass.

'15. Clark D. Abbot is Assistant Engineer in the Inspection Department of the Associated Factory Mutual Fire Insurance Companies, 31 Milk Street, Boston, Mass. His home address is 23 Bowers Street, Newtonville, Mass.

'15. Frank P. Cartwright is Assistant Engineer of the Rochester Bureau of Municipal Research, 25 Main Street East, Rochester, N. Y. His home address is East Bloomfield, N. Y., care of B. D. Cartwright.

'15. Carl C. Cooman has been elected an Associate Member of the Society of Civil Engineers.

'15. Henry Gardner Lehrbach, of the U. S. Navy, has been transferred from the Lieutenant Corps of Civil Engineers at the Charleston Navy Yard to Assistant Public Works Officer, Naval Base, San Diego, Cal. He has recently been made an Associate Member of the American Society of Civil Engineers.

'15. Charles A. Mengers is a Squad Boss in the drafting room of the U. G. I. Contracting Co., Philadelphia, Pa. His home address is 3145 Atlanta Road, Camden, N. J.

M. C. E. '15. Jacob O. Jones, Assistant Professor of Hydraulics in the University of Kansas, Lawrence, Kansas, has been elected an Associate Member of the American Society of Civil Engineers.

'15. Howard B. Wright is an estimator for the Semet-Solvay Company, builders and operators of by-product coke ovens. He is at present engaged in making valuations on Semet-Solvay property and plants for the purpose of increasing insurance valuations. His home address is 126 Mildred Avenue, Syracuse, N. Y.

'15. Oscar E. Zabel, who is with the Eastman Kodak Company, has changed his address to R. F. D., Rochester, N. Y., care of C. W. Porter.

'16, '17. Charles Eppleur, jr., is in the Sales Department of the Consolidated Steel Corporation, 165 Broadway, New York City. His home address is 266 East 162nd Street, New York City.

'16. Charles P. Frost, who is with the Carson Construction Co., Gordon, Ga., has changed his address to 102 West Henry Street, Savannah, Ga.

'16. Fred C. Griffith, who is with the Turner Construction Company of New York City, gives his address as 287 South Jones Street, Lock Haven, Pa.

'16. A. F. Perry, jr., is Superintendent of Transportation and Mining with Buckman and Pritchard, Inc., Mineral City, Fla. He writes that H. B. Pope, '14, is with the Turner Construction Co. at Pierce, Fla.

'16. Murray N. Shelton gives his present address as Central Y. M. C. A., Buffalo, N. Y.

'17. Jacob Fruchtbaum is an Engineering Salesman with the Truscon Steel Co., Syracuse, N. Y. His home address is 771 Irving Avenue.

'17. J. H. Gray, who is with the White Fireproof Construction Co., 95 Madison Avenue, New York City, has changed his address to 615 Jefferson Avenue, Elizabeth, N. J.

'17. Harold E. Wong is now with Dr. C. E. Wong on the Chinese Eastern Railway in Manchuria. His home address is Kailan Mining Administration, Tientsin, China. Mr. Wong was engaged in Y. M. C. A. work among the Chinese laborers in France during the war.

'18. H. F. Chadeayne was married on September 20 to Miss Mildred R. Brady of Annapolis, Md. Mr. Chadeayne is Treasurer and Assistant Manager of the Allied Industries of Cornwall, N. Y.

'18. Yu-fong Sun is Section Engineer with the Peking-Suiyuan Railway and has charge of laying track on a thirty mile extension. His home address is 2 Taku Road, Tientsin, China.

'18. Kirkland Wiley Todd, who is with the National City Company, is located in 318 Farmers' Bank Bldg., Pittsburg, Pa. He was married to Kathryn Kerr on January 24, 1920. His home address is 613 Whitney Avenue, Wilkensburg, Pa.

'19. Announcement is made of the engagement of Miss M. C. Fleet, daughter of the late Mr. and Mrs. John P. Fleet, of East Neek, N. Y., to T. Fletcher Cochran. Miss Fleet is a graduate of Wellesley, and Mr. Cochran is with the American Manufacturing Company, West and Noble Streets, Brooklyn, N. Y.

'19. John C. Gebhard is an estimator with the Bethlehem Steel Corporation, and his address is 234 Wall Street, Bethlehem, Pa.

'19. Reginald Waldo is connected with the Water Resources Branch of the U. S. G. S., 605 Temple Court Bldg., Chattanooga, Tenn.

'20. James S. Engel has changed his address to 615 Quiney Street, Brooklyn, N. Y.

'20. Charles J. Howell has been lately transferred to the waterworks sales department of the Pittsburg-Des Moines Steel Company. Last winter he was a member of the Pittsburg Athletic Club

(Continued on next page)

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wrestling team, and expects to be on the team again this winter. He lives at 928 Western Avenue, Pittsburg.

'20. Ernest W. Steel is a Project Engineer of the Virginia State Highway Commission. Mr. Steel is the State's representative in the district near Quantico, Virginia. His home address is Maple Shade, New Jersey.

'20. Robert Schempf is with the Jobson-Gifford Company, 30 East 42nd Street, New York City. His home address is 423 East 85th Street, New York City.

M. C. E. '20. Chien Hsien Wang is an Assistant Engineer in the Works Department of the Chili River Commission at Tientsin, China.

'20. Chia T. Yeh is now living at 76 West Thirty-sixth Street, Bayonne, N. J.

ENGINEERING OF MEN

(Continued from page 51)

would occur and they would be sure to get hurt. I made it clear to them that I was some prophet in Apache lore, and they saw what I meant. Then I rode off and never looked back. In an hour they hauled their wagons some miles up above the pass and we left them there the rest of the season. I had happened to notify them in the name of the company that their business interfered with ours and did it before their camp was established, a good legal point which I blundered upon. I showed them

I was not afraid and was in earnest. They fell back. They always will. In Grant's first battle, he happened to think that the enemy was probably as badly scared as he was and that the enemy's cause was less just. So, in the engineering of men, when you must cope with the lawless element, have right entirely and clearly on your side. Then sail in. If you do not run, the other fellow must, finally. If this incident should catch the eye of any of the old T. and P. men, I wish to say that that fellow could have been tamed two years before, **I think**, and by the same method.

A labor union is not omnipotent. If you will read in the last **Century** for May, in "The Topics of the Times," you will find that no one claims any more than 25 per cent. of the labor in this country is organized. They tell you, too, that a labor union must have its own way and that the minority of labor must rule the majority of labor. Personally, I am ashamed of the way we allow labor unions to dominate us to-day. I think I see the turning of the tide. Labor unions are not at all what they were five years ago, and, unless I mistake not, we are going to see much less trouble with labor unions than we have had. It is a fact determined by the Commissioner of Commerce in the East that 10 per cent. of our labor is idle all the time; of the 90 per cent. employed, one-third is idle some part of each year. That is a sad thought. I believe honestly

(Continued on next page)

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that what we need in this country to-day is not higher wages, but steadier work. I believe that labor unions are working in the other direction. What they want is higher wages and more men put on for a part of a time. The ironclad pay-roll—by that I mean uniform pay-roll—has worked great mischief in this country, and in my judgment, is a confession of weakness on the part of the employer and engineer. Why should we pay an Italian laborer, who cannot understand our language at all and who is undersize, as much as we pay a Scandinavian or German, who speaks our language and who eats as much as anybody? (Laughter.) Is there any sense in it? We do it to save trouble. If you are like I am, you do it because you are too lazy to do anything else.

Now, I ran against this ironclad pay-roll idea, when a youngster, in Texas. We had been building the Texas and Pacific, and the farther we got away from Fort Worth, the poorer our engineering employees were, because other roads came in and took our best men. It was necessary to do something, or our work would be badly crippled. They brought me back to Fort Worth, to build toward Denver. I spoke to the Chief Engineer and said: "Let me fix the rate of pay," and explained my ideas. He said: "I fear you will have trouble; but, all right, try it out." I did; I worked for the company seven years after that, and I always fixed the rate of pay for engineers under me. I always kept the best men, the poorer men I did not give so much. On the average, I paid less than the company gave. I would start the new men at the lower rate of pay. I said: "I can raise you, and if you think you are not being

paid enough, tell me." When I handled engineering parties I always fixed the engineers' pay, and I never had an engineer quit nor ask more pay or less work.

In recapitulation I would say that as engineers we have drifted from our moorings. We must get back to the view of the Stephensons and the fathers of engineering, and not only be engineers of design, but engineers of men. To do so, two things are necessary: The courage of our convictions and a knowledge of the teachings of the Carpenter of Nazareth, 1900 years ago, "Love your neighbor as yourself." Now, your employee should always be your **near** neighbor.

The military organization is a good foundation, and coupled with it is the broad law of the army officer to "care for his men."

Strikes are blind barbarism and economic waste. Engineers can do more to prevent and more to stop them than any other class of professional men. It is our duty. Shall we then be men of affairs in this as in so many other ways now? The present time is most opportune. The labor strike is failing and passing. May we, as engineers, inherit our own kingdom and bless mankind? May we take upon our shoulders this phase of the white man's burden? I commend to my brother engineers these lines of Foss as our watchword:

There are hermit souls that live withdrawn,
In the place of their self-content;
There are souls like stars, that live apart,
In a fellowless firmament;
There are pioneer souls, that blaze their path,
Where the highway never ran;
But let **me** live by the side of the road
And be a friend to man.

THE CORNELL CIVIL ENGINEER

and

Transactions of the Association of Civil Engineers of Cornell University

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No. 4

EDITORIALS

STUDENT CHAPTERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

As a result of the statement that, "The A. S. C. E. does not make a practice of establishing student chapters," which was contained in an editorial on that subject in the December number of the CIVIL ENGINEER, we have received several notifications that such is not the case. As a matter of fact, the Society has changed its previous policy in this matter and the December number of the Society's "Proceedings" contains the following list of student chapters: Stanford University, Pennsylvania State College, University of Pennsylvania, Rensselaer Polytechnic Institute, University of Washington and University of Cincinnati. All of these chapters were established during the year 1920, and are subject to the following conditions:

RULES ADOPTED BY BOARD OF DIRECTION FOR FORMATION OF STUDENT ORGANIZATIONS

"1. Student chapters, each composed of students of a school of engineering of recognized reputation, may be affiliated with the American Society of Civil Engineers upon favorable vote by the Board of direction. The name of such affiliated society shall be 'The* Student Chapter of the American Society of Civil Engineers;' except that, in case a previously existing society becomes so affiliated, it may substitute its established name (with a local word included, if necessary to distinguish it) in place of the standard designation indicated by the blank spaces.

"2. The qualifications required of a proposed student chapter shall include:

- (a) Organization in an engineering school of high standing;
- (b) The endorsement of the application by the head of the civil engineering department;
- (c) Exclusive occupancy of the field, at least as far as senior and junior civil engineering students are concerned; and
- (d) A minimum membership of twenty-five students.

* For example, "Columbia University," or "Cornell Association of Civil Engineers."

"3. Each affiliated society shall establish its own rules of government and procedure, but conforming with any regulations that may be formulated by the American Society of Civil Engineers. It is also intended that it shall control the occurrence and character of its meetings; but the American Society of Civil Engineers desire especially to aid in promoting their success and value by frequent consultation and advice, as well as by arranging for speakers, on request, whose addresses will broadly supplement the class work of the member. Each student chapter will also submit an annual report, not later than the last day of December of each year, which shall include:

- (a) A summary statement of the meetings held during the calendar year, giving the date of each, the attendance, the principal speaker and his subject, and other pertinent information;
- (b) Names of the officers, and of the members by classes, at the date of the report; and

"4. Any address or paper read before a student chapter may be offered for publication to the American Society of Civil Engineers under the general provisions established for this procedure, and shall be submitted to the Board of Direction when requested by the said Board or when such chapter desires to publish it in a local journal or elsewhere, it being understood that the privilege of priority in publication exists in the American Society of Civil Engineers, though the Society claims no exclusive copyright upon such papers.

"5. The annual dues of each student chapter shall be \$10 per year, which, under provisions approved by the Board of Direction, shall entitle it to:

- (a) A copy of each issue of the **Proceedings** of the American Society of Civil Engineers;
- (b) The opportunity to publish notices of its chapter activities, etc., in publications of American Society of Civil Engineers.
- (c) The privilege of having its printing done at cost by the Society; and
- (d) The active co-operation of the American Society of Civil Engineers in advancing

the interests of each student chapter by contributing (from its organization, membership, and experience) such service as may be mutually arranged.

"6. Among the privileges offered to the members of student chapters are:

- (a) Individual subscription to the **Proceedings** of the American Society of Civil Engineers at a special price to be fixed by the Board of Direction.
- (b) A membership card, of special design, to be issued annually through the officers of each student chapter;
- (c) The right to attend the meetings and accompany inspection trips and excursions arranged for members of the American Society of Civil Engineers;
- (d) Provision for the publication of requests for summer employment during the college course, or for permanent engagement after graduation on such terms as the Board of Direction may prescribe; and
- (e) The opportunity to hear, on special occasions, speakers whose personal experiences qualify them to speak with authority upon the many questions that are of particular importance to the student during his college course."

Do we want to apply for a Student Chapter of the A. S. C. E.? Think it over, fellows, and speak up at the next meeting of the Association.

ALUMNI CORRESPONDENCE

Managing Editor,
Cornell Civil Engineer,
Ithaca, N. Y.

Panama, R. de P.
With the Greetings of
December 25, 1920.

Dear Sir:

I wish that I had time to write you regarding "China's Grand Canal," "Yellow River Silt," and several other subjects dealing with engineering work in China—all of them very interesting to me; but my notes are all in the States.

The subject of roads in Panama does not now lend itself to a suitable technical paper. Existing traffic requires no roads at all but future development will be negligible until roads are built, the plan at present being to spend about \$6,000,000 in four years. Specifications have been prepared since September, and laws to which no experienced contractor would conform have recently been amended. We hope to advertise for bids soon after the first of January.

Yours very truly,

J. W. Beardsley, C. E. '91

71 West 35th Street,
New York City.

The Cornell Civil Engineer,
Ithaca, N. Y.

Gentlemen:

You have aptly brought up at this time, the question of the liberal education of the engineer,—a subject largely discussed and one that undoubtedly is deserving of serious consideration.

The writer, in the eight years that he has been out of college has had occasion, in covering considerable territory, to come in contact with a considerable number of engineers. Except for those who are leaders in their profession and whose broadening self-education has largely accomplished this result, I have found engineers with their interests strikingly confined to technical work. Traveling the narrow confines of a technical path is of value to neither the engineer nor the community of which he may be a member. The broadened vista obtained by a knowledge of cultural subjects, as well as those involving the economics of industry, is of inestimable value to the engineer in his own work. It furthermore expands his mental capacity to enjoy and interpret those things about him which occur in the daily life, literature, art and drama of the country in which he lives. Such diversion of the mind into channels other than those technical, is a rest for it, making it more capable to handle difficult engineering problems.

It is anomalous that the leading engineers of this country, as well as those executives whose technical walk in industrial life virtually makes them engineers, have all been men of tremendously broad vision and keen foresight. They are men whose broad education has enabled them to meet others in different walks of life on a parity—an advantage to be gained only by a liberal education.

Among the essential subjects comprising a liberal education for the engineer, I would mention the following in the order of their importance as expressed by my own personal opinion, namely: English, English Literature, Foreign Languages, Psychology, Business and Contractual Law, Economics, Industrial Relations and the essentials of Engineering Architecture.

The accomplishment of such an extensive program could be attained in one of two ways:

FIRST—By lengthening the ordinary engineering course to five or six years.

SECOND—By utilizing the Summer school sessions.

It would unquestionably be a better plan to add the additional year if possible, for this would conserve the mental capacity of a student and permit him to exercise those student functions which are very nearly as essential as the education itself. The additional time would furthermore permit of a better grounding in the essentials of engineering which were, in the writer's opinion, too lightly passed upon

at the time he took his course. Eight years have been sufficient to show him that the vast majority of engineering knowledge is founded on these essential principles which govern almost all forms of design.

In conclusion let me say that I speak as one who has obtained the unquestionable benefits of a liberal education by having taken the combination six year academic engineering course. I have often remarked that I not only felt the six years entirely justified, but that the mental expansion resulting in broadened vision has been obtained entirely through the medium of a liberal education.

Very truly yours,

Mareel K. Sessler, C. E. '13,
General Manager,
AMERICAN SPIKE COMPANY.

Santiago de Cuba,

Editor,
CORNELL CIVIL ENGINEER,
Ithaca, N. Y.

Dear Sir:

In answer to the request in the November issue of your magazine for an expression of opinion about liberal education for engineers, I venture to say that the actual curriculum in all engineering colleges is out of date.

The aim of all scientific schools, Cornell included, is to cram a boy with a lot of useless archaic stuff that limits his horizon to the four walls of an engineering office, or to the tent of a construction camp.

Modern life is so complex and varied that a man with such an antiquated training will very seldom get to a high civic position, as he has no other ideas and aims in life than those found in the Trantwine or in the Mechanics of Engineering.

Let the engineer have a liberal education and he will surely enter other activities than those strictly connected with his chosen profession; and from a tool of financiers and lawmakers he will convert himself into a leader of men.

The transition curve is all right but its use is circumscribed to railroads, while good courses in civics, finances, sociology, and public speaking will open to the engineer many doors in public and private life that are now closed to those who still think that they can repeat with Monte Cristo "The World is mine," by merely acquiring a college degree while missing a liberal education.

It seems to me that the Cornell Engineering schools should engage in pioneer work for a liberal education for engineers either by adopting a six year course or by requiring an academic degree of those entering said schools, just as it was done by

the Cornell Medical College at New York about ten years ago.

Your objection to said six year course, as given in the last number of your paper, must be reconsidered as it is not fair to let the pocket book of the poorer students dictate the length of the college courses.

It also seems to me that a conference of all engineering schools would be just the thing to solve the present problem, after the alumni of those schools have given their opinion on the matter.

We engineers are still traveling in stage coaches in these days of airplanes and wireless telegraphy, and it behooves us to wake up to the fact that times have changed, and proceed accordingly.

Yours sincerely,

Juan Aguilar, C. E. '08.

Editor Cornell Civil Engineer,
Ithaca, N. Y.

Dear Mr. Editor:

I have read, with much interest, the editorial, "The New Problem," in the "Civil Engineer." I note the expression of a desire to join the A. A. E. and I take the liberty of urging those to act who feel the need of such an organization. Surely if a Cornell Civil Engineer feels the need of an employment agency, in addition to help from the faculty and Cornell associations, he should join the A. A. E. or any other effective organization.

Your mentioning the Am. Soc. of C. E. in connection with other engineering societies deserves a word or two extra for the Am. Soc. of C. E. It has never been an organization conducted along popular lines. Its whole effort has been to advance the science of the profession of civil engineering. Its success has been unequalled in the societies of this country. Membership in such an organization is to be sought, worked for and cherished as an honor.

I feel it my duty to call your attention to the possibility of creating an erroneous impression about the progressiveness of the west and the comparative negativeness of the east which you call conservatism. This is an expression much overdone and very much used when popular fallacies are being urged upon an intelligent community. I make this most general statement as food for thought, "The self-styled progressives have generally been wrong."

In conclusion, permit me to state that new things are not always desirable and that it is a mark of rare ability to be able to distinguish the good new ones from the bad.

Yours very truly,

Robert J. Harding, 1903.

SPECIAL NOTES

FINANCIAL ENGINEERING

By O. B. GOLDMAN

This book is a discussion, for the benefit of both practicing engineers and students, of the question of economical efficiency in engineering design. It solves the problem of the selection of pumps, engines, and boilers so that the service rendered will be given at a minimum cost and indicates the reasons why a machine may be economical in service even when its first cost is apparently high.

After some preliminary definitions, the author establishes the meaning of his term "**Vestance**", which may either be "Operating Vestance," that is, the capitalized amount of the operating charges or costs, or "Depreciation Vestance," that is, the present worths of the investments and re-investments on account of depreciation. Comparison of their sum, or the "Total Vestance," with the effect of taxes and insurance added, thus makes possible an economical installation on the basis of the least cost for the service rendered.

About a quarter of the book is devoted to an admirably arranged schedule of basic costs, of such prime movers as steam engines, many types, motors and generators, and gas engines of many types; of boilers, air-compressors, stokers, and condensers; of different kinds of water pipe, canals and tunnels, and finally of entire hydro-electric plants. The author points out that the variation in prices of the same article, sold by different manufacturers is often due to their lack of knowledge of exact unit costs and one chapter is devoted to an analysis of the several factors that properly determine the just selling price. He also explains that the variation in price with time is due to the varying value of gold and that his prices may readily be converted into prices applicable to any date by modifying them according to the changed value of the dollar.

The latter half of the book is a series of examples and discussions, showing how the total vestance can be worked out for many involved and complicated problems. For example, he finds the relative economy of various power units, at various loads in operation for different times, with several costs of fuel and with money at different rates of interest. He finds the most economical pump to install for a given service, whether running under full load or part load and both for full time and for infrequent or limited periods. He also shows how this same vestance may be used to select economical pipe lines.

One of the many criticisms voiced lately against engineering schools has been that they have failed to insist upon the limitations of cost in the development of engineering theory. This book, if used as a textbook in a regular course, would make such a

criticism untenable. That it is possible to so use it is indicated by the author who says that students in the college where he is the professor of Heat Engineering are greatly interested in the subject matter and "seek it with greater avidity than any other course."

H. N. O.

ANNOUNCEMENT BY THE AMERICAN ROAD BUILDERS' ASSOCIATION

The good roads movement in the United States and Canada will receive a strong impetus when good roads advocates to the number of several thousand gather in Chicago, February 9 to 12 next for the Eleventh American Good Roads Congress and Twelfth Good Roads Show to be held at the Coliseum. The Congress and show are being organized in connection with the Eighteenth Annual Convention of the American Road Builders' Association which embraces in its membership highway officials of the national government and the states, counties, cities and townships in the United States and Canada, together with highway engineers and contractors and the manufacturers of road building machinery, road materials and highway transportation equipment.

The topics selected for discussion will bring together for an exchange of views large numbers of highway officials and engineers, congressman and legislators. There will be a large attendance of army, automotive and chemical engineers, agriculturists, bankers, motorists and large users of trucks, machinery manufacturers, dealers in highway materials and road contractors, together with members of chambers of commerce and boards of trade and other organizations interested in road and street improvement.

A special feature for which most elaborate preparations are being made, will be the "Good Roads Show" which will open at the Coliseum, February 9. More than forty thousand square feet of floor space will be devoted to exhibits of road and street materials, road-making machinery and automobiles, trucks, trailers and other highway transportation equipment. The closest co-operation is assured from highway officials, contractors, engineers and manufacturers to the end that the exposition may be made the most notable ever organized. Both the Congress and the show will be held under the same roof, the convention hall being on the floor above the exposition.

Everywhere among road-builders the outlook for unprecedented activity growing out of the delays that were due to the heavy cost and scarcity of labor materials during the war, is most promising, and optimism, therefore, seems certain to prevail throughout the sessions of both the Congress and the convention.

THE LANGLEY FIELD, VA., SEWERAGE SYSTEM

By FORD KURTZ, C. E., 07, M. A. S. C. E.

Concerning the general topography of the county, the special features of the system, the sewage disposal plant, the ejectors and their operation, and the general operation of the plant.

Langley Field, the first permanent Aeronautical Experimental Station of the U. S. Army Signal Corps, located about 3 ½ miles north of Hampton, Va., is ideally situated for both airplane and sea-plane operations. Two sides of the Field front on branches of Back River, a tidal stream emptying into Chesapeake Bay, while the entire reservation of 1,655 acres has a range in elevation of only ten feet. That portion of the reservation fronting on the Southwest Branch of Back River, a mile in length and extending a quarter of a mile back from the shore, was chosen as the site for the town, which was laid out to include a large number of laboratory buildings, shops, barracks, dwellings, hangars, school and administrative buildings. The layout of the streets and principal buildings is shown in Figure 1. All streets were of concrete with separate concrete curb.

The highest point of the townsite is about 10 feet above the plane of mean low water, the datum adopted for all work at Langley Field, while the lowest portion before any grading was done was at Elevation -0.3. Upon completion of the dredged fills the highest street was at Elevation 9 and the lowest at Elevation 6. Mean sea level is at Elevation 1.3, average high tide at Elevation 2.5, and average spring tide at Elevation 3.0. The highest tide observed during the period while design work was in progress rose to Elevation 4.1, which was 1.5 feet higher than the predicted tide for that day at Old Point Comfort (Fortress Monroe). The highest predicted tide at the latter place for the year 1917 was Elevation 3.5, so it was considered possible that storm and wind occurring at that time might cause a tide as high as Elevation 5. Before the close of the construction period, the tide on two occasions rose nearly to Elevation 6 during north-east storms. Local information indicated that on rare occasions the tide had risen even higher, possibly to Elevation 7.

The type of buildings adopted required in general a minimum depth of invert for laterals of 5 feet below corresponding curb grade. In general curb grades were the same as or a few inches lower than crown grades of the concrete roadways. This requirement and tidal conditions as stated made pumping of the sewage necessary even if disposal by dilution had been possible. The fact that treatment of the sewage prior to discharge into Back River was necessary simply added to the height to which the sewage had to be raised.

In order to avoid excessive depth of trenches the sewerage system was divided into two separate sections, the East and the West, and a standard grade of 4 feet per thousand was adopted, with compensation of 0.001 ft. per degree for curvature. Practically all of the sewer lines are 6 inches in diameter except the mains in the immediate vicinity of the pumping, or ejector, stations. This arrangement involved a maximum trench depth of about 15 feet.

In order to avoid disturbance of the concrete roads, both during construction, and afterward in maintaining the service mains for sewers, water, gas, steam, electrical conduits, etc., a system of "service lanes" was laid out which in general either followed lot lines through the center of blocks, or occupied a strip of the lot frontage, with a minimum of crossings under streets. The sewers were placed in the center of these "service lanes", so that where sewer fronts on street, its center is 15 feet inside the property line and where it runs through center of blocks it follows the lot line. The invert grades at the center of manholes are shown on Figure 1.

Ground water was encountered in practically all of the trenches and in some cases the bottom of the trench was very soft. In order to avoid excessive infiltration of ground water into the sewers, all joints, not only for laterals and mains, but also for house connections, were made with a bituminous compound. The use of this type of joint was fully justified by tests of infiltration made on completed lines, the amount of infiltration being very small. When soft ground was encountered the pipe lines were laid on 2 inch plank with blocking to prevent lateral movement prior to backfilling, or, in the case of very soft ground, on 2 inch plank supported every four feet on 2 inch by 10 inch plank driven vertically into the bottom of the trench by hand.

Manholes have a maximum spacing of 125 feet, except in a few special cases. They are two types: deep, and shallow. Deep manholes have an invert depth of 8.17 feet or more below finished grade, and shallow manholes range from 5 to 8.17 feet in depth. The sides of deep manholes are vertical from floor elevation to a point three feet above, and the sides of shallow manholes to a point not less than 2½ feet above floor line. These sections with vertical sides are circular and have an interior diameter of 4 feet. Above these cylindrical portions, the sides of deep manholes are brought in



FIGURE 1.

with a straight batter to a circular section of 26 inches interior diameter at the base of the manhole frame, while the sides of shallow manholes are arched to a circular section of 26 inches in diameter at the base of the frame.

The manhole floors were of concrete, 8 inches thick below invert level. The channels were built up vertically from the springing line of the pipe to the elevation of the crown, which elevation was called floor level for the manhole. The floor sloped toward the main channel with a pitch of 6 inches in 2 feet. The walls above floor level are of brick 8 inches thick from top of manhole to a depth of 10 feet, below which point they are 12 inches thick. Iron steps were built into the walls at intervals of 14 inches. Light pattern manhole frames and covers were used since no manholes are located in streets. The covers are ventilated and galvanized iron dust pans provided.

The adoption of the flat grade already mentioned rendered the use of automatic flush tanks advisable. The location of these is shown in Figure 1. Two types were used, viz: the simple flush tank and the combined manhole and flush tank. The first type was used where a flush tank was required at intermediate points in a lateral, while the latter was used at the head of each lateral. The tanks have concrete floors and brick sidewalls with the same frames and covers as used on standard manholes. The tanks are 4 feet in diameter from floor elevation to a point $2\frac{1}{2}$ feet below top of manhole cover, while above that point the design is the same as that of a typical shallow manhole.

Simple flush tanks are located on one side of the lateral and are connected thereto not less than 30 feet beyond a manhole and by means of a Y turned down the grade so as to properly direct the flow.

They are provided with 5 inch Miller siphons of standard design. The feed pipe is fitted with brass cock and regulator for controlling the rate of supply to the flush tank. The regulator is of such type as will insure regularity of flow without stopping of the pipe and discharge not less than 250 gallons in 24 hours under a pressure of 40 pounds per square inch. Combined manholes and flush tanks are provided with 5 inch Miller siphons of Miller-Potter design in which the upper end of the sewer lateral is provided with a blind flange, which can be removed when it is desired to inspect or clean the line.

The sewage disposal plant as originally planned consisted of a screening chamber, Imhoff tank, dosing chamber, and four contact beds. The 12 inch outlet pipes for the contact beds discharge into the Southwest Branch of Back River, the inverts being at Elevation 3. The elevations of the various parts of the disposal plant are such as to permit of gravity flow from screening chamber to outlet with complete discharge of the contact beds with tide at Elevation 4. The only effect of the occasional higher tides will be that the contact beds cannot be completely emptied. Maximum elevation of water in Imhoff tank is 16 and in screening chamber 17. A detailed description of the Imhoff tank with cuts and photographs was published in Engineering News-Record, Vol. 83, pp. 374-377 on August 21, 1919, together with a description of proposed dosing chamber, sprinkling filters and sedimentation basin to replace the dosing chamber and contact beds of the original design. To date the Imhoff tank is the only portion of the disposal plant that has been constructed.

All dwelling house connections to sanitary sewers are 6 inch diameter and spurs for same were spaced every 60 feet on each side of sewer lines,

where they ran through the middle of blocks, and the same distance on one side only of sewer where it fronts on streets. Where the invert of the sewer at any point is more than 8 feet below corresponding curb elevation, the spur for either one or two dwelling house connections consists of a 6 inch Y branch with the branch set in a vertical plane facing upward. To this is connected a curve of such design that its bell end is horizontal when properly set in place. The riser is then extended upward with 6 inch pipe and a single Y branch set where sewer fronts on street and a double Y branch where sewer runs through middle of blocks, both at such an elevation that the placing of a curve in the bell of the branch for beginning the house connection line places the invert of the house connection not less than 5 feet below curb elevation. Where the invert of the sewer at any point is less than 8 feet below corresponding curb elevation, the spur for each separate dwelling house consists of a 6 inch Y branch, with the branch set at such an angle that the placing of a curve in the bell of the branch for beginning the house connection line places the invert of the house connection at once at the elevation of the crown of the sewer main.

Ejector Stations

Each of the two separate sections of the sewerage system discharges to an automatic ejector station, from which the sewage is forced to the screening chamber of the disposal plant. The discharge lines are 6-inch cast iron bell and spigot pipe with lead joints and are of nearly equal length, viz: about 2,300 feet. In each station are installed duplex 150-gallon Shone ejectors, operating alternately, as is described later, and each discharging in one minute. The average total lift, including friction, for the ejectors is practically the same in both stations, viz: about 34 feet. Air supply for the ejectors is ultimately to be provided from the power house through a 2½-inch line to each of the stations. The working pressure in the storage tank in each station is 50 pounds per square inch. The tank is provided with a reducing valve which normally regulates the pressure in the line leading to the ejectors to 20 pounds per square inch, but is capable of adjustment for variations in both directions.

The relative advantages of centrifugal pumps and air operated ejectors for small sewage pumping stations were considered at some length before deciding upon the method to be used at Langley Field. In this connection the Norfolk and Portsmouth, Va., pumping stations were visited. The former city uses centrifugal pumps and the latter has used Shone ejectors for upwards of twenty-five years. In the final analysis the avoidance of screening at the pumping stations, and doing away with installation of electric motors in a damp pit wholly below surface grade outweighed the higher

efficiency of pumps compared with ejectors. It was also feared that even with screening of the sewage before pumping, a great deal of trouble would be encountered with the small size pumps which would have been used. In an ejector station there is very little maintenance cost, compared with the cost of clearing the screens and removing trash from a pumping station and the cost of maintenance work on the pumps themselves. The objections of discontinuity of discharge in the case of ejectors and high rate of discharge in order to prevent sewage backing up in the mains during a long period of discharge (such as one minute) were overcome by the use of duplex ejectors with the special alternating device, the general idea of which was evolved by the writer and the details worked up by the Yeomans Brothers Company, of Chicago, agents for the Shone ejector.

The ejectors are located in a concrete pit of 14 feet internal diameter. The floor of the West Station is about 21 feet below surface grade and that of the East Station about 19 feet. The floors are 26 inches thick and reinforced against uplift, while the walls are 15 inches thick. The roof is of precast concrete slabs 2½ inches thick and 2 feet wide by 2 feet 9 inches long. These are laid dry on 10-inch 25-lb. I-beams with hot pitch poured in joints between slabs to prevent leakage. The pits have 8 inches of backfill over the roof and are provided with standard sewer manhole frame and cover. The I-beam supports are not concreted in place so that the entire roof is easily removable in case one of the ejector pots must be removed from the pit.

In the manhole adjacent to the north side of each ejector station is a 12-inch emergency overflow to the nearest storm sewer manhole. These emergency overflow lines are provided with 12-inch backwater valves to prevent storm water or high tides backing up into the sanitary sewers. These emergency overflows will only come into service if the ejector station is completely shut down. The sewage will then back up in the sanitary sewers until it has reached the elevation of the overflow and the raw sewage will then be discharged through the storm sewers directly into the Southwest Branch of Back River.

Sewage enters the West Ejector Station through a 10-inch cast iron pipe and passes through an 8-inch gate valve which can be closed, thus cutting off the flow from both ejectors and forcing the sewage to rise in the mains and pass out through the emergency overflow. This would only be done when both ejectors were out of service due to repairs being made, or to accident. Passing the 8-inch valve above mentioned, sewage enters each of the ejectors through a 5-inch gate valve and is discharged from the ejectors through a 5-inch gate valve into the common 8-inch discharge line. By closing the inlet and discharge gate valves of either

ejector it is completely cut off from the system and can be dismantled without interfering with the flow of sewage through the other ejector. Both the inlet and the outlet of each ejector are also provided with special flap check valves. The check valve on the inlet is open and that on the discharge closed when the ejector is being filled with sewage from the main, and vice versa when sewage is being discharged from the ejector through the force main to the sewage disposal plant.

Sewage enters the East Ejector Station through two 6-inch cast iron pipes and passes through an 8-inch gate valve on each line before it enters the ejector pots. By closing the northerly 8-inch valve, the entire flow from the main line of the East Section of the sewerage system is cut off from both ejectors, forcing the sewage to rise in the mains and pass out through the emergency overflow. By closing the southerly 8-inch valve, the entire flow from the short line to the east of the seaplane hangar is cut off from the station, but as no separate emergency overflow is provided for that line, care must be taken at such a time to see that no sewage is allowed to enter this line as it would flood the main and discharge from the top of the manholes. Therefore in cutting out both ejectors in this station the 5-inch gate valves on the inlet pipes to the ejectors should be closed and the two 8-inch gate valves on the main line left open, unless it is necessary to make some repairs on the lines between the 5-inch and the 8-inch valves. In this way the short line to the east of the seaplane hangar will be connected to the emergency overflow. In other respects, operation of the East Station is exactly the same as for the West Station.

The air supply for operating the ejectors enters the station through a $2\frac{1}{2}$ -inch pipe and passes through a $2\frac{1}{2}$ -inch valve, which serves to cut off the air from the station when so desired. Passing the valve, the air enters an 18-inch by 72-inch receiver from which it is piped to the ejectors. The receiver is provided with a blowoff cock to drain water, oil, etc., that will collect in the tank. The air enters the operating mechanism of each ejector through a valve which can be closed to cut off the air supply from that ejector when it is not in operation. After passing these valves the action of the air is best followed by referring to the "Piping Diagram of Duplex Ejectors and Alternating Valve," shown in Figure 2. The air leaves the ejector through an exhaust line which is also provided with a shutoff valve to be closed when the ejector is not in operation, since the exhausts from the two ejectors are joined in a common exhaust main to atmosphere.

The automatic action of the Shone ejector depends on the movement of two open cast iron actuating bells, which are linked to each other by a

rod. The bronze rod to which the upper bell is attached passes through a stuffing box and connects by means of links to a lever with counterweight. The rising or falling of the bells operates the D slide pilot valve of the automatic air valve through a rocking shaft connecting it with the center of motion of the lever. The automatic air valve is pressure operated, piston type and controls the air supply to and exhaust from the ejector pot. The lower actuating bell has the open side facing up, so that it is always full of water, while the upper actuating bell has the open side down so that it will trap air as the sewage rises above the lip.

At the end of the discharging period the level of sewage in the ejector pot is well below the top edge of the lower bell, at the position indicated in Figure 2. The actuating bells are at that time in their lowest position—about $1\frac{1}{2}$ inches below their highest position. The exhaust to atmosphere now being open, the sewage enters the pot through the inlet check valve and begins to fill the pot, rising until it traps air in the upper bell. When this happens sewage rises into the cast iron pipe which serves as air inlet and outlet between the automatic valve and the ejector pot. It is therefore necessary to provide a small opening between this cast iron pipe and the upper bell compartment in order to equalize the water level in them. If this opening were not provided, or becomes clogged, there would be no outlet for the air in the upper bell chamber and the water would not rise high enough to float the upper bell. When the level of the sewage has risen to a certain height above the edge of the upper bell, the flotation due to the trapped air therein will lift both of the bells. The lifting of the bells operates the sliding pilot valve, as already described, and this in turn operates the automatic air valve in such manner as to admit pressure to the ejector pot. This pressure closes the check valve on the inlet to the ejector pot and opens the check valve on the discharge, thus forcing the sewage into the force main.

The valve lever is offset considerably above its fulcrum in such manner that the leverage of the counterweight about the fulcrum (which is the center of the rocking shaft) is a minimum when the actuating bells are in their lowest position. As the flotation of the upper bell lifts the two of them and at the same time lowers the counterweight, the leverage of the counterweight increases and that of the bells decreases, thus causing the bells to rise and the counterweight to fall very quickly once motion has begun. However the most important effect of the offset lever is that as the level of the sewage in the ejector pot falls, the actuating bells do not drop when the trapped air is released from the upper bell, for the increased leverage of the counterweight and decreased leverage of the bells

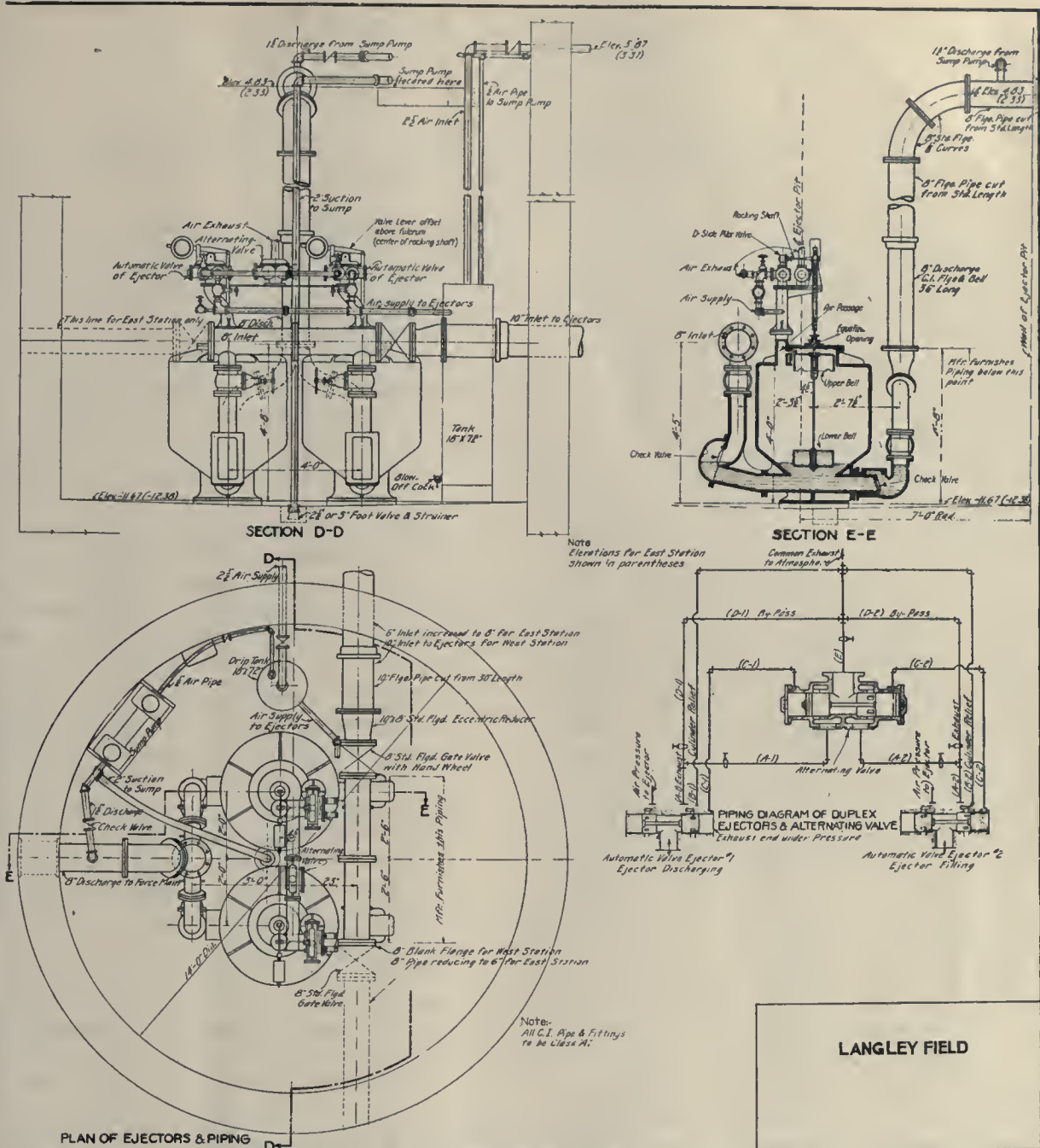


FIGURE 2.

requires a greater force to lift the counterweight from its lowest position than was required to permit it to drop. The design is such that the bells do not drop and the counterweight rise until the level of sewage in the ejector pot has fallen considerably below the top edge of the lower bell. Just as before, the movement is very quick once motion has begun, due to the change in leverage as motion proceeds. There is also always some friction in the bell rod stuffing box which is sufficient to overcome any tendency to shifting in case the counterweight should not be set absolutely correctly. In the course of time, the lower bell will fill up with sediment and the counterweight will have to be moved out a trifle on the lever to compensate for increased weight in the bell.

While the ejector is discharging the position of the pilot valve is such that it admits air to the exhaust end of the automatic valve. In this position of the automatic valve the ports leading from the air line to the ejector pot are open while the exhaust ports are closed. When the pilot valve moves on the completion of discharge the exhaust end of the automatic valve is connected to atmosphere through the pilot valve and the pressure end is connected to the air pressure through the pilot valve. This causes the automatic valve to shift, thus cutting off air pressure from the ejector pot and opening the exhaust ports so that the sewage can enter as the air discharges. This is the operation of a single ejector.

(Continued on page VII)

PRACTICAL DRAINAGE OBSERVATIONS

By CARL A. GOULD, C. E. '07

A brief outline of the history of drainage, the knowledge essential to the contractor, the determination of a Judicial Ditch in southern Minnesota.

Although the French claim to have discovered drainage at Maubeuge, Northern France, in the early 17th century, it was left to the English to rediscover some two hundred years later. The fact that it was discovered is the important thing, as drainage has contributed immensely to the world's wealth during the past few years. We have but to look at Holland to realize the value of proper and adequate drainage of marsh land: it is indeed the basis of all Dutch prosperity. In the Fens of England about 700,000 acres have been reclaimed, and millions of acres of marsh land in Italy have been turned into fertile fields by means of the several different methods of draining land.

The first wet land in the United States to be brought under more intense and efficient cultivation by the use of tile, was on what is known as the "Johnston and Yoeman" farm of Western New York, in the year 1835. As soon as the crops began to show an improvement on this farm, as a result of the tile drains, the news travelled rapidly among the farmers of the then cultivated lands of this country, and there was found to be such an improvement of the crops grown on drained land, over those raised on the undrained land, that tile drainage began to be employed in many sections of the United States, so that to-day there is not a single state in which cannot be found, drainage systems of one sort or other, all of which are directly contributing to the immense agricultural wealth of the United States.

Much has been written on the subject of drainage. The United States Department of Agriculture has issued numerous bulletins, based on surveys and investigations along practical lines, such as: production of fruits, grains and vegetables, on experimental farms; the amounts of water needed on different classes of soil for the most economic production; general formulae to be used and methods to be employed in laying out drainage systems, etc. The Coast and Geodetic Surveys have done much to promote the drainage work on a big scale; the Climatological Reports of the Weather Bureau Stations offer an additional source of information which has a great deal of bearing on the design and location of large drainage systems. Aside from all that the different branches of our government have done to promote the reclaiming of wet lands, we have many scientific works covering all the various branches of drainage, and in planning our systems, either large or small, we cannot overlook the prac-

tical experience of the drainage contractor and engineer from which we are able to get facts concerning the cost of installation, methods of operation, and results accomplished.

In my own experience, as drainage engineer and contractor, I have found that engineers, as a rule, are over-zealous to put through a project, especially if the actual benefits derived figure very closely to the cost of the installation: This zeal, on the part of the project engineer, shows itself in many different steps along the way of placing the project "on its feet" so to speak. Aside from the usual scrupulous investigation of the terms of the contract and specifications, I consider the following items of prime importance to the contractor, if he is to place an intelligent bid upon any drainage project:—

1. Approximate determination of the drainage area, aside from reference to engineer's plans.
2. Normal weather conditions. (From Climatological Reports).
3. Extent and duration of maximum rainfall. (From Climatological Reports).
4. Test-holes in the material to be excavated, sufficient to determine the character of the soil. (Usually taken 1,000 feet apart).

The writer has installed one drainage project, of about fifty miles in length, where the work was at a standstill for six weeks, during the very best of weather, because the engineer in charge of the project failed to provide a main outlet of sufficient size to carry off a maximum rainfall within the allowable time. (Outlet should be large enough to carry off a maximum rain-fall within forty-eight hours).

This proved to be a big contingency item in the expense of installation, as there were two excavator crews which were on a monthly basis and, of course, had to be retained until such time as the construction work could proceed.

Insufficient main outlet has, in many cases, been a great disappointment to land owners along the project, as the maximum rainfalls cause water to stand on the crops long enough to spoil them, when just a little more money, spent in the increasing of the main channel size, would have saved their crops and made the system a success under all conditions.

Land owners always place confidence in the drainage engineer, otherwise he wouldn't be employed, and when they plant their crops in newly

drained land, watch them grow to almost maturity, and then see them flooded and die, due to a heavy rainfall on the water-shed, they immediately place the blame where it belongs: upon the engineer.

Aside from the waste entailed, as a result of poor design, many contractors engaged in the drainage business have lost their money and entire outfits.

Just as there are hidden values in any industry, so there are hidden elements of expense which arise in the construction of all drainage work: this may be called the element of chance for which the wise contractor provides, when placing his bid for the job: usually 15 to 20% should be allowed for unforeseen expense on drainage projects of moderate size; the larger the project, the less will need to be allowed for this item.

With the data now available which may be used as a guide for the engineer and contractor, there should be very little chance of failure either of the contractor, the engineer, or the project. The methods employed in the United States for the construction of drainage projects may, in general, be divided into four classes: 1. Hand labor. 2. Team labor. 3. Machine work. 4. A combination of any or all three of the above. The writer has found the following table to be a very close approximation to the cost of hand labor on the drainage ditches of Minnesota and Iowa:

| Size of Tile. | Price per rod per 3 ft. depth. | Price to add for each inch depth over 3 ft. per rod. |
|---|--------------------------------|--|
| 5" | \$0.45 | \$0.02 |
| 6" | .45 | .025 |
| 7" | .50 | .025 |
| 8" | .55 | .025 |
| 10" | .65 | .03 |
| 12" | .75 | .03 |
| 14" tile @ \$0.40 per rod for each foot depth | | |
| 15" " | .45 | " " " |
| 16" " | .50 | " " " |
| 18" " | .55 | " " " |
| 20" " | .60 | " " " |
| 22" " | .65 | " " " |
| 24" " | .75 | " " " |
| 30" " | 1.00 | " " " |

For excavation depths of 10 feet or over, the above prices must be varied according to the character of the soil, and especially when the test-holes show evidence of quick-sand which is quite common in some localities.

For team and machine work the costs are quite different, and depend on the class of machinery used, and the advantage to which the teams can be worked. Drainage machines are now built adaptable to every sort of trench, or channel design, and which are capable of being moved over any kind of soil regardless of water or other obstacles. Small projects are usually figured on a hand labor basis, and if the contractor is fortunate enough to

have machinery which can be placed on the work, he is that much ahead. After all, the drainage of land is not so different from other business enterprises; one must have enough money to carry on the work without handicap, must employ the right materials, methods, machines and men.

One of the best assurances of a satisfactory completion of any contract job is daily inspection of the work being done by the engineer; in fact, almost constant inspection is necessary on some of the wet ground work, due to the encountering of underground streams and quicksand, which call for special construction methods.

To the engineer entering the drainage business, remember: The laws governing the design and construction of drainage projects are just as exact and definite as those employed in the design and construction of a steel bridge, although there may be a little more variation in the application of the drainage laws. If, in the laying out and designing of your projects, you exhaust every source of information bearing on your particular problem, and use the best formulae obtainable covering such work, your reputation will be in the process of building, and the project will not be a disappointment.

Below is given a brief history of a Judicial Ditch in Southern Minnesota, which may be considered as the average size of the tile drain now being installed in this locality.

Location—Murray and Nobles County, Minnesota.

QUANTITIES INVOLVED

| TILE. | | Lin. Feet. | Total Weight, lbs. |
|----------|-------|------------|--------------------|
| Kind. | Size. | | |
| Clay | 6" | 4,000 | 40,000 |
| " | 7" | 4,200 | 50,400 |
| " | 8" | 5,900 | 88,500 |
| " | 9" | 1,300 | 26,000 |
| " | 10" | 3,800 | 95,000 |
| " | 12" | 4,400 | 140,800 |
| " | 14" | 7,700 | 308,000 |
| " | 15" | 3,500 | 171,500 |
| " | 16" | 3,800 | 203,300 |
| " | 18" | 3,200 | 198,400 |
| Concrete | 20" | 3,300 | 402,600 |
| " | 22" | 2,100 | 323,400 |
| " | 24" | 2,000 | 340,000 |
| " | 30" | 5,150 | 1,339,000 |

Totals; 54,350 3,726,900

This ditch includes only the main lines of tile, it being left to the land owners to supply whatever laterals they wish. The County and Judicial Ditches, as a rule, only lay the main arteries of the drainage system.

The work of constructing the ditch was started in May, 1916, and completed in December of the same year. The tile, sizes 20" to 30" inclusive, were delivered at the nearest railroad station on flat cars

(Continued on page VIII)

THE CORNELL CIVIL ENGINEER

PUBLISHED MONTHLY DURING THE COLLEGE YEAR BY
The Association of Civil Engineers of Cornell University, Ithaca, N. Y.

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COLLEGE NOTES

C. E.

Basketball.

With the intercollege basketball season barely open, the team representing the College of Civil Engineering has shown up so well that it will put a strong bid in for the intercollege trophy. Three games of the schedule have already been played and all resulted in decisive victories for the C. E. team. The first game played against Architecture resulted in a score of 18 to 6 in favor of C. E. This game was very ragged and showed a decided lack of team-play on both sides due to the fact that neither team had had an opportunity to practise before its first game. Very soon after the game against Architecture, however, regular practise was held by the C. E. team improving the team-play considerably and resulting in a score of 30 to 8 in the game against the Veterinary five. The score of the third contest, played against Arts, would tend to indicate that the game was very close. As a matter of fact the C. E. team rolled up 12 points to Arts' 9 without any apparent exertion whatsoever. The Arts five worked very hard to stem the tide of defeat which seemed to come so easily from the hands of the C. E. men. But it was in vain, for the C. E. aggregation played smoother and more consistent basketball than their opponents. At the time of going to press the C. E. team and the Ag team are the only remaining quintets in the intercollege league who have been undefeated. C. E. heads the league with three games won and none lost while Ag is second with two games won and none lost. Arts and Vets have each lost one out of their three games played, Law lost two out of three while Chem., M. E. and Architecture have lost every game played thus far. Judging from these figures, then, we repeat that the outlook for C. E. Basketball is very encouraging.

A great deal of credit due for the success of C. E.

in basketball must not only go to the team and its Manager but also to Prof. Conwell who is faculty director of college athletics. It was mainly through the efforts of Prof. Conwell that the C. E. team was able to secure the use of the gym at a time when there is nobody around to molest the squad while it is practising. Prof. Conwell is also present at each practise and at each game and follows the playing of his men very closely. The actual training of the men on the squad, however, is in the hands of F. O. Schreiner, '22, and R. Becker, '22, both of whom were on last year's C. E. team and who are now on the Varsity basketball squad and both of whom still play on our C. E. team. Besides Schreiner and Becker our present C. E. team consists of W. M. Allen, '23, a member of the Varsity squad, T. Telfer, '23, a member of last year's freshman team and C. J. Schmauss, '23, who distinguished himself on his prep school team. This formidable aggregation bids fair to win the intercollege trophy in basketball and give to Dean Haskell the honor of hanging another pennant in our trophy room in the college library.

M. E. and C. E. Colleges Combine.

The consolidation of Sibley College and the College of Civil Engineering was officially authorized by the Board of Trustees at its meeting on January 8, to take effect with the beginning of the second semester, February 11.

Prof. D. S. Kimball will be dean of the new college, which will be subdivided into the Sibley School of Mechanical Engineering, the School of Civil Engineering, and the School of Electrical Engineering. Directors have been appointed to take charge of the three schools, Prof. Herman Diedericks, '97, Prof. F. A. Barnes, '97, and Prof. A. M. Gray, respective-

ly. These officers will assist Dean Kimball in the administration of their branches of the college.

Dean A. W. Smith, '78, of the Sibley College and Dean E. E. Haskell, '79, of the College of Civil Engineering have been granted sabbatic leaves of absence for the second term of this year, at the end of which both will retire.

The Cross-Country Team's Trip to England.

Cornell may well be proud of the showing made by its cross-country team in England against the Cambridge-Oxford team. The Cornell team was

running in a new climate, over an unfamiliar course, and but a week after they had made a hard ocean voyage, and yet they performed excellently, being defeated by a picked team from two universities by a score of only 29 to 26.

The cross-country team has been practising all the Fall with this English meet in mind. Coach Moakley laid out a steeplechase as nearly as possible like Roehampton course in England.

The men who made the trip are Captain J. L. Dickinson, '21, N. P. Brown, '21, T. C. McDermott, '21, R. E. Brown, '22, C. C. Carter, '22, H. V. Bonsal, '23, and M. E. Richmond, '23. Coach Moakley, J. P. McGovern, '00, and Manager C. C. Bailey accompanied the team.

On the evening of December 11 the team, together with the rest of the cross-country squad, were the guests of honor at a concert by the Musical Clubs in Bailey Hall. On the evening of December 13 the team was entertained at a banquet at the Cornell Club in New York City and later saw the show at the Hippodrome as the guests of the management. On the next morning, the team sailed on the Aquitania and arrived in England on December 21.

During the time before the race on December 30, the men were kept hard at work, practising running over the seven and one-half mile course of the Thames Hare and Hounds Club at Roehampton, England. The course includes three severe water jumps, a long stretch of plowed field, and numerous hills.

On the day of the race a large crowd turned out to the event. The spectators showed great sportsmanship during the entire race and cheered the American runners as much as the English. At the beginning of the race, McInnes of Oxford took the lead and was never headed, although Carter followed him closely and finished second. During the entire race, McDermott and W. A. Montague of Oxford struggled for third place, McDermott finally winning out, notwithstanding the fact that Montague is the holder of the record of the course and one of the strongest runners in England. The other men who counted in the scoring, in the order that they finished were, W. T. Marsh of Cambridge, N.

P. Brown, W. R. Seagrave of Cambridge, R. E. Brown, W. H. Grave of Oxford, and H. V. Bonsal. The English were amazed at the showing of the Cornell team since the English team was considered the best one they have had for twenty years, and since the Americans were running on unfamiliar ground while the English were at home.

The team sailed for home on January 1 and returned to Ithaca in the latter part of the first week after the Christmas vacation.

The Christmas Trip of the Basketball Team.

During the Christmas vacation the basketball team made a trip, meeting Ohio State at Columbus, Yale and the University of Pittsburgh at Pittsburgh, and the University of Buffalo at Buffalo. Although the team lost to both Ohio State and Buffalo by the narrow margin of one point, it redeemed itself by the manner in which it downed the two more formidable teams.

The first game was on December 31, with the Ohio State team which defeated the Cornell team by a score of 23 to 22. The score at the end of the first half was 15 to 14 and the Cornell team was unable to overcome this slight advantage in the second half.

On New Year's Day the Varsity met Yale and outplayed them at every stage of the game, rolling up a score of 26 to 17. The score at the end of the first half was 11 to 8 in favor of the Blue and White team but in the second half the Varsity played an entirely different style of basketball and the New Haven guards were unable to break up the accurate passing and shooting of the Cornell team. The scoring of Sidman from the foul line, who scored nine goals out of thirteen tries, and the consistent playing of Captain Molinet were largely responsible for the Cornell victory.

On January 3 the Varsity completely overwhelmed the hard fighting Pitt aggregation, taking a 34 to 23 victory. The covering of Sidman was one of the features of the contest, the little guard holding the much heralded Jordan, Pitt's star forward, to two baskets. Sidman also did excellent work in shooting, both from the foul line and from the floor, scoring 20 of the 34 points rolled up by the Varsity. The game was nip-and-tuck during the whole of the first half and at the end of the period the score was 14 to 13 in favor of Cornell. During the second half however, the Red and White team was never bothered.

In the game with Buffalo on January 4, Cornell was defeated by a score of 23 to 22. The foul shooting of Cohen, one of the Buffalo forwards, was largely responsible for the defeat of the Cornell team. The Cornell team worked well and faithfully, but the strain of the trip had its effect and they were unable to overtake the Buffalo team.

Beginning what promises to be a very successful season and perhaps the means of conveying another championship to Cornell, the varsity basketball team defeated the team from Old Nassau here on Dec. 20, to the tune of 24-21.

Princeton arrived in Ithaca with a record of three victories in as many attempts. She was considered a powerful aggregation and one whose outlook was very bright. At an early hour, the stands encircling the court were filled to capacity, necessitating the hurried erection of several hundred additional seats.

Princeton started the game in a whirlwind fashion, scoring three field goals and a basket resulting from a Cornell foul. It was at this moment that Cornell pulled itself together. From then on until the final whistle blew, it was a very well fought and closely contested game, neither side being able to gain an advantage of more than three or four points.

Remarkable team play on the part of the Cornell five was responsible for their triumph. Coach H. Ortner, '19, is to be congratulated in putting forth a team of such power so early in the season.

A New Baseball Coach.

John J. Carney of Boston was appointed Varsity Baseball Coach by the Baseball Committee of the Major Sports Council on Thursday, December 2. Carney comes to Cornell with a high record as coach, manager and player. Mr. Carney played on big league teams for five years. He has been coaching baseball for the past twenty years, turning out winning teams for Phillips-Exeter Academy for the past ten. He also turned out men at Exeter who, when they went to college, invariably pulled down positions on the baseball team. For the past five years Yale baseball captains have been former Exeter players coached by Carney. John J. Carney is a man of high moral character, of strong personality, and of proven ability as a coach, and, while we do not expect him to produce a championship team next year, we do expect to witness a remarkable improvement over last year and we have faith in the results which the "Carney System" will produce in a very few years.

Coach Carney will take up his residence in Ithaca in February and will issue a call for candidates soon after the opening of the second term. Preliminary practice work will start at that time in the cage.

Defeating Amherst by an unanimous vote, the Cornell Debating team scored it's second consecutive victory in as many debates. Having overwhelmingly defeated Dartmouth two weeks ago, the varsity is well on it's way to a successful season.

The subject of the debate was "Resolved: That the courts should not interfere by judicial decision with the right of parties to an industrial dispute to employ any means that are not illegal for an individual." The Cornell team, supporting the affirmative, easily downed the arguments of their opponents and put forth arguments of their own which could not be side-tracked.

According to the Amherst-Cornell debating agreement, "The award was made on the basis of arguments, as presented, and not upon the merits of the question."

Organization of Independents.

The non-fraternity men of Cornell organized themselves into a body known at the Cornell Independent Association at a meeting held in Bailey Hall on the evening of December 7, 1920. Professor Bristow Adams acted as temporary chairman at the meeting, and he introduced Acting President Smith who opened the discussion with a short talk. A tentative constitution was then adopted providing for the offices of president, vice-president, secretary and treasurer, and in addition five men, who, with the officers will constitute the executive committee. The officers will be elected in the early fall and will hold office for one year. The organization will hold two regular meetings each term to be called at a time selected by the executive committee. The following men were elected officers of the Cornell Independent Organization: F. K. Bentel, '21, president, R. E. Brown, '22, vice-president, J. S. Hays, '22, secretary, and E. L. Rieh, '21, treasurer. The members of the executive committee are: A. G. Ashcroft, '21, J. H. Burke, '21, N. R. Pirnie, '21, R. H. Smith, '21 and P. O'Keefe, '22.

The purpose of the newly formed organization, as stated in the constitution, is "to promote the best interests of Cornell through the expression and execution of the opinion of the independent men." In his speech, Acting-President Smith expressed surprise at the fact that the Independents had not organized a long time ago. He also stated that "if this organization is worked out carefully and effectively a new day for the men of Cornell, a stronger day for Cornell, will dawn, and a greater opportunity will be offered to those men who have come here to educate themselves." Two things, important in the life of Cornell, may result from the formation of the Cornell Independent Association provided the organization does not go quickly astray by setting themselves against fraternities, existing organizations and existing policies. The first result which the Independent Organization may achieve is more satisfactory representation on the Student Council, and the second is a formation of a Cornell

(Continued on page 84)

ALUMNI NOTES

'79. Frank W. Skinner, Editor of "Public Works" and Consulting engineer is now living at 74 Central Ave., Tompkinsville, N. Y.

'89. Anson Marston, who is Dean of the Engineering School of the Iowa State College, has been appointed chairman of an advisory board on highway research which will work thru the National Research Council. The work of the board, which will begin soon, will consist of a thorough investigation of all highway problems. It is expected that this careful research by experts will lead to a more advantageous expenditure of the annual appropriation for highways, which amounts to nearly one million dollars. The result of the board's activities will be made available to highway builders throughout the country.

'96. Joseph C. Hilton is Superintendent with the Foundation Co., 120 Liberty St., New York City. His home address is 187 North Eighteenth St., East Orange, N. J.

'01. Ralph F. Proctor is chief engineer of the Maryland Casualty Company of Baltimore. His home address is 143 West Tamale St., Baltimore, Maryland.

'05. Lef Winship, formerly Assistant Chief Engineer for the Missouri, Pacific Railroad with headquarters at St. Louis, Mo., has been appointed Division Engineer with headquarters at Nevada, Mo. He may be addressed there in care of the road.

'06. Joel D. Justin is Chief Engineer in the Department of Hydro-electric Plants for the Ludlow Engineers of Winston-Salem, N. C.

'07. Mr. and Mrs. Fred H. Ferguson have announced the marriage of their daughter, Lueretia Hinkley Ferguson, A. B. '19, to George H. Rekate, on October 1, at Buffalo, N. Y. Mr. and Mrs. Rekate are now living at 137 Erie Street, Lancaster, N. Y.

'08. New Year Greetings have been received from Juan E. Aguilar, who is City Engineer and a member of the firm of Chalons and Aguilar, Engineers and Contractors, of Santiago, Cuba.

'08. Alvin Leroy Gilmore is now President of the Binghamton Engineering Company. His address is 185 Washington Street, Binghamton, N. Y.

'08. M. C. E. '09. The offices of the Smallman-Brice Construction Company, of which Ralph A. Smallman is Vice-President and Treasurer, are now located in their own building at 1109-15 Avenue E, Birmingham, Ala.

'09. Mr. and Mrs. Fay H. Battey, 50 Inwood Place, Buffalo, N. Y., announce the birth of a son, John Klein, on October 20.

'09. Clinton B. Stewart, Consulting Hydraulic engineer, is now residing at 2321 Rowley Ave., Madison, Wis.

'09. Isidore Walzer has been elected an Associate Member of the American Society of Civil Engineers. He is County Assistant Engineer for the New York State Highway Commission at Mineola, Long Island.

'10. Edward V. Baron, who is Chief Engineer of the Priest Rapids Irrigation District in Washington, has been transferred from Associate Member to Member of the American Society of Civil Engineers.

'10. George H. Canfield is Hydraulic Engineer with the U. S. Geological Survey at Juneau, Alaska, where he may be addressed.

'10. Clement E. Chase was appointed principal assistant engineer on the technical staff for the study of the site type and estimated cost of construction of the proposed bridge across the Delaware River from Philadelphia to Camden. His appointment was approved by the Interstate Bridge Commission on November 19. Mr. Chase has been with R. Modjeski for the past ten years and is now in charge of Mr. Modjeski's New York Office. He may be addressed at 101 Park Avenue.

'10. Charles W. Fitch is in charge of the engineering and development of Lyon Park, Va. This is a suburb of Washington, and is on the highest point in the section overlooking Fort Myer to the North. It is but twenty minutes ride from the center of the business section via Washington-Old Virginia Railway.

'10. Herbert D. Kneeland of 230 Breeding Avenue, Ben Avon, Pittsburgh, Pa., reports the birth of a daughter, Evelyn Marie, May 13. Mr. Kneeland is Production Manager of the United Engineering and Foundry Company of Pittsburgh.

'10. Lionel M. Levine has opened an office at 29 Broadway, New York City, for engineering practice, especially as applied to construction and mechanical equipment of refrigerating plants, packing plants, and tanneries. He lives at 530 Manhattan Avenue.

'10. Fredric Vieweg is assistant general manager, in charge of production with the American Trona Corporation. The plant is located on Searles Lake in the Mojave Desert in California, and the products are muriate of potash and borax, which are extracted from a natural brine by steam evaporation and subsequent crystallization. Vieweg says that "American made potash on a commercial scale is an accomplished fact, and analyzes ten per cent higher than that produced by our late enemy in his palmiest days."

'11. Nathan R. Finkelstein has recently been elected secretary and treasurer of Sam Finkelstein & Company, Inc., 801-807 Broadway, New York

City. His home address is 157 West Seventy-ninth Street.

'11. Howard S. Warner is with the Martin Engineering Corporation, engineers and contractors, with offices in the Gluck Building, Niagara Falls, N. Y.

'12. Thomas W. Blinn is still with the Detroit Edison Company, but he has changed his home address to 749 Crawford Avenue, Detroit, Mich.

'12. Edmund Lynch is a Sanitary Engineer for the American Sheet & Tin Plate Co., 1410 Frick Building, Pittsburgh, Pa. His home address is 39 South Emily Street, Crafton, Pa.

'12. Charles R. Meissner is now experimental engineer with the H. Koppers Company, of Pittsburgh, Pa. He lives at 306 Kenmount Avenue.

'12. Alfred K. Starkweather, who is an engineer with the New York Telephone Company, is living at 8 Hawthorne Avenue, Clifton, N. J.

'13. Charles F. Bauer, Assistant Engineer with the Mason & Hanger Company, Gettysburg, Pa., has been elected an Associate Member of the American Society of Civil Engineers.

'13. E. R. Davis, formerly Assistant City Engineer of Newport News, Va., has been promoted to the position of Chief Engineer. He may be addressed at his office in the City Hall.

'13. Clinton S. Hunt has returned from an eight months stay in Bolivia, where he was making an investigation of water power in and around La Paz for the Electric Bond and Share Company, of 71 Broadway, New York City.

'13. Paul J. Maxon is an engineer with the National City Company of New York. He is in charge of construction and alteration work, and at present is directing the renovation of the old Hotel Manhattan into an office building. His home is at 50 Palisade Avenue, Bogota, N. J.

'13. Roger W. Parkhurst gives his present address as care of Barber Asphalt Paving Co., 1605 Woolworth Building, New York City.

'14. Herbert B. Pope is with the Turner Construction Company, at Pierce, Fla.

'14. Adrian K. Webster is improving a section of land in Texas which he has owned for a number of years. He has harvested two crops from one hundred and fifty acres, and now has two hundred and twenty-five acres in cultivation. He is raising cattle and hogs, and expects to add sheep this winter. He says he likes the change from engineering, and that he would be glad to have any Cornelian visit him at any time while passing through the "Panhandle of Texas." His mail address is Box 3, Vega, Texas.

'14, M. C. E. '15. Charles S. Whitney is now with Hool and Johnson in the Colby & Abbot Building, Milwaukee, Wisconsin.

'15. Fernando de la Cantera, who was formerly a professor in the University of Philippines, is now

with the Manila Engineering Company, Manila, P. I.

ex '15. Howard S. Rappleye of Ithaca is a computer with the United States Coast and Geodetic Survey at Manila, P. I.

'16. A daughter, Mary Melissa, was born on December 15, 1920, at Hampden, Va., to Captain and Mrs. Gerald E. Brower.

'16. Mr. and Mrs. W. H. Jackson announce the marriage of their daughter, Ruth Elizabeth, to Wayne MacVeagh on October 13 at Blairsville, Pa. Mr. and Mrs. MacVeagh are making their home in Sharon, Pa. Their mail address is P. O. Box 726, Sharpsville, Pa. Mr. MacVeagh is in the Engineering Department of the Valley Mould and Iron Corporation at Sharpsville.

'16. John R. McCarty has been transferred to the Philadelphia office of the Crow-Levick Company, 111 North Broad Street. He was formerly in the Wilkes-Barre office.

'17. James A. Anderson has been elected an Associate Member of the American Society of Civil Engineers. He is a professor of Civil Engineering at the Virginia Military Institute.

'17. A son, Henry Huntington Batjer, jr., was born on June 8 to Mr. and Mrs. Henry H. Batjer, 546 Hickory Street, Abilene, Texas. Mr. Batjer is Assistant City Engineer of Abilene.

'17. Gabriel E. Lund is Field Engineer on the construction of sugar mills for the West India Sugar Finance Corporation at Cayo Mambi, Cuba.

'17. Donald A. Mackenzie is a computer in the engineering department of the Aluminum Company of America, Maryville, Tenn. His mail address is P. O. Box 452, Maryville.

'17. George Miller, Engineer in the Highway Dept. of the Baldwin Locomotive Works, has moved to 54 Black Rock Ave., Bridgeport, Conn.

'17. W. LeRoy Saunders is district engineer with the Concrete Steel Company of New York, with headquarters in Washington, D. C.; he lives at 1501 Park Road.

'19. Mrs. Guy W. Shoemaker, of Elmira, N. Y., has announced the engagement of her daughter, Gladys Drake Pence, to George E. Knowlton, jr., of New York.

'19. Homer R. Seely is Resident Engineer for the Bethlehem Steel Bridge Corporation on the construction of a dirigible hangar for the United States Navy at Cape May, N. J.

'19, M. C. E. '20. Chilton A. Wright is a topographic surveyor with the New York Water Power Investigation at 84 Pine Street, New York City. His address is 22 Kress Park, New Rochelle, N. Y.

'20. Thomas F. Cochran was married on the second of December to Miss Mary Crozier at Huntington, Long Island, N. Y. Mr. and Mrs. Cochran are at home at 257 Renshaw Avenue, East Orange, N. J.

In Memoriam

Archibald Byron Lueder, C. E. 1889, M. A. Soc. C. E.

Died at Morristown N. J., on August 21, 1920

Archibald Byron Lueder was born at Nanticoke, Pa., on August 26, 1876. He entered Cornell University in the Fall of 1895 and graduated from the College of Civil Engineering in 1899, at which time he started as timekeeper upon construction work with the Berlin Iron Bridge Company of East Berlin, Conn. After serving for a time as foreman of erection with this Company, he was sent in the Spring of 1901 by the American Bridge Company as agent and assistant engineer on the construction of twenty-eight viaducts and bridges on the Uganda Railway in British East Africa, Port of Killandini. This interesting construction work was carried out under unusual difficult conditions. The railway was constructed through an uncivilized section of East Africa, and most of the work was done with native laborers who had had no experience in steel construction work.

Upon the completion of this work, he returned to America in the Spring of 1903 and was employed by the American Bridge Company as assistant engineer upon the construction of a number of bridges for the Wabash Pittsburgh Terminal Railroad, between Mingo Junction, Ohio, and Pittsburgh. From the Fall of 1904 to February, 1909, he was assistant engineer with the same Company in charge of the erection of steel work in the New York district. Some of the work included Rolling Lift Bridge, Vernon Avenue, Brooklyn; Belmont Race Track Grandstand, Belmont Park, L. I.; Waverly (N. J.) Warehouse for Carnegie Steel Company; Hackensack River Drawbridge for the Erie Railroad; replacing 2-span bridge over Central Railroad yards at Jersey City, N. J., for the Lehigh Valley Railroad, and Ferry House at the foot of West 23rd Street for the Delaware, Lackawanna and Western Railroad.

In February, 1909, Mr. Lueder joined the Merrill, Ruekgaber Company and continued with this company until December, 1912. The work constructed under his supervision during this period included steel and concrete highway bridges and concrete sewer on Broad Street, Stapleton, S. I.; some difficult sewer construction on Malta Street, Canarsie, Brooklyn; and the construction of Evitts Creek Reservoir, and Dam at Cumberland, Md.; which included nine miles of wood stave pipe.

In December, 1912, Mr. Lueder was superintendent for the Arthur McMullen, Snare & Triest Company for the construction of the 125th Street Section of the Lexington Avenue Subway, and, after this work was well under way, he was sent by Snare & Triest Company to Conquimbo, Chile, in charge of the construction of ore docks for the Bethlehem Steel Company.

Returning from Chile during the Spring of 1915,

he was first employed by the Jarrett Chambers Company, and later by the Phoenix Construction Company, upon construction work at the Power Plant, Omaha, Neb.

Mr. Lueder was connected with the Electric Bond & Share Company as manager of construction work from the Summer of 1916 until early in 1919; among jobs of which he had charge during this time were the following:

Installation of 15,000 kw steam turbines at Omaha, Nebraska, with the construction of condensing water intake of about 100,000 kw capacity on the Missouri River, involving deep cofferdamming.

Installation of 10,000 kw steam turbogenerator at Wichita, Kansas, with condensing equipment, boilers, spray pond, etc.

Installation of 15,000 kw steam turbogenerator at Fort Worth, Texas, with condensing equipment and boilers and with the construction of condensing water intake and tunnel on the Trinity River.

The year 1919 was devoted to the development of oil properties near Fort Worth, Texas, Mr. Lueder being president of the Phoenix Oil Company which he organized and managed until it was necessary for him to give up his work because of ill health, which developed early in 1920.

Mr. Lueder, in addition to being very competent in directing construction work, was a genius in overcoming difficulties, and he possessed fine human qualities, which enabled him to build up an organization by gathering together a loyal and efficient construction force.

"Pop" Lueder, as he was known while at Cornell, was a very popular member of the Class of 1899. For three years he was one of the mainstays of the Football Team. He also scored many points for the Varsity Track Team as a Hammer Thrower. He was a member of Rod and Bob.

Mr. Lueder was married in June, 1903, at Morristown, N. J., to Mary Rosevear, who, with one son, Reginald, survives him.

CHARLES A. KAIN, C. E. 1895

Died at New York City on August 24, 1920.

Charles A. Kain died on August 24, 1920, at New York City, having succumbed to Hodgkins disease of the glands, an illness from which he had been suffering for two years. At the time of his death, he was in his fifty-first year.

Mr. Kain received his degree in Civil Engineering at Cornell University in 1895. From that date until 1914, he was employed in various capacities for the American Bridge Company. For the past few years he has been a structural engineer for the Aluminum Company of America, located at Pittsburgh, Pa.

(Continued on page VII)

COLLEGE NOTES

(Continued from page 80)

Union. Of these two, the more pressing is the representation on the Council, and the change in the old order of representatives will doubtless make things lively next year. Plans are now in progress for a Junior Week Dance, to which all members of the University and their guests will be invited. This will establish a new custom at Cornell and will probably mean that non-fraternity men will take a more active part in the mid-year festivities. The future activities of the Cornell Independent Association will be watched with eagerness by every member of the university community and it is hoped that these activities will all be for the best interests of Cornell.

C. E. ASSOCIATION LECTURE

Several meetings have been held this term to which all of the students of the newly formed College of Engineering have been invited. Each meeting has been under the auspices of one of the undergraduate engineering societies, and the lecture given on Friday, December 17, was the first to be held under the auspices of the Association of Civil Engineers.

Mr. Walter L. Webb, C. E. '84, M. C. E. '89, was invited by Dean Haskell to explain to us the work of the Valuation Section of the Rents, Requisitions, and Claims Service of the A. E. F. He gave a very interesting, detailed description of the way Uncle Sam paid for the privilege of helping out our European friends. Mr. Webb was a Major in the Engineers Corps and was in charge of the work of the Valuation Section.

It is regretted that the meeting came at a time, just before the Christmas vacation, when so many of us were so rushed with work and when there were so many other attractions. Had the meeting been held on a more favorable date there would have been many more present to appreciate Mr. Webb's talk.

The 1920 Football Season.

In spite of the fact that the two big games of the season resulted in defeats, the 1920 football season has been a very successful one here at Cornell. The Big Red Team won six out of its eight games and rolled up a total score of 231 points to their opponents' 68. The improvement over last year was very much marked and Coach Gilmour Dobie proved that his system, which will really come into its own next year, was right. During the fall victories were registered over St. Bonaventure, Union, Colgate, Rutgers, and Columbia. The first defeat of the Varsity came at the hands of Dartmouth by a score of 14 to 3. The biggest surprise and disappointment of the season came on

Thanksgiving Day at Philadelphia, Penn., with what turned out to be a rejuvenated team, made four touchdowns and held the Varsity scoreless. The statistics of the football season show that Cornell is fourth in the number of total points gained; that Mayer and Kaw took third and fourth places, respectively in the individual scoring; that Carey placed fifth in the number of field goals kicked and also that he kicked one of the three longest field goals this season; and that Mayer placed fifth in the number of goals kicked after touchdown. The sporting writers concede Cornell fifteenth place on their list of best teams this year. This is quite high when it is remembered that last year we were not even considered.

The prospects for next year are very bright indeed, due to the fact that we are losing only four or five men from the Varsity. Coach Dobie will have a nucleus of about seven veterans around which to build a team next fall. Horrel, center, Jewett, fullback, Mayer, left halfback, Pendleton, guard and Hoff, quarterback are the only men who will be likely to leave. Coach Dobie after deciding on his lineup at the start of the season made few changes except in the backfield where he tried out numerous men before deciding definitely on any four. The final decision for the last four games came to be Mayer at right half, Carey at fullback, Kaw at left half, and Hoff at quarterback. The end positions were the next most changed on the team with Munns and Finn playing more than anyone else. Dodge and Miner played throughout the season at right tackle and right guard respectively. Pendleton and Knauss played the left side of the line regularly but Goetz and Kay got into nearly every game to relieve these two regulars. The following men were awarded their "C" in football: E. J. Hoff, C. E. '21, T. D. Finn, C. E. '22, S. B. Horrell, '21, Clyde Mayer, '21, F. S. Pendleton, '21, W. S. Dodge, '22, W. P. Goetz, '22, H. R. Kay, '22, W. P. Knauss, '22, H. G. Miner, '22, J. E. Wahl, '22, C. L. Brayton, '23, W. D. P. Carey, '23, H. L. Ebersole, '23, E. V. Goninlock, '23, E. L. Kaw, '23 and D. A. Munns, '23.

This year the season was a success but we do not hesitate to say that next year's football season at Cornell will go down in the history of Eastern football. Contrary to rumors abounding on the Campus, Cornell will have a captain of the football team next year in the personage of W. S. Dodge, '22, stellar tackle this year and a member of the varsity last season while in his Sophomore year. Dodge is a resident of Cleveland, Ohio, having played football there at the University School for several years. Cornell's All-American quarterback several years ago, "Chuck" Barrett '16 also attended the same institution in his prep school days. Clyde Mayer '21, was elected honorary captain of the 1920 team

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LANGLEY FIELD SEWAGE SYSTEM

(Cont. from page 75)

The operation of the duplex ejectors with alternating device is as follows: Ejector No. 1 is discharging and the exhaust end of automatic valve is under pressure. Connection C1 supplies pressure also to the corresponding end of the alternating valve, forcing the piston over toward unit No. 2, opening No. 2 exhaust (A2) and closing No. 1 exhaust (A1). When Ejector No. 1 has completed its discharge, the automatic valve shifts, closing the air supply to the ejector and opening the exhaust ports in the automatic valve. The air displaced by the piston in the exhaust end of automatic valve No. 1 is relieved through the pilot valve and cylinder relief connection (B1) to atmosphere. This also connects No. 1 end of alternating valve to atmosphere, but the position of alternator piston remains unchanged until Ejector No. 2 has filled and begins to discharge. When Ejector No. 2 discharges the exhaust end of the automatic valve is under pressure, which is also communicated to No. 2 end of alternating valve through connection C2. The alternator piston shifts to No. 1 position, closing No. 2 exhaust and opening No. 1 exhaust, permitting Ejector No. 1 to refill. By-pass connections D1 and D2 are provided so that the alternating valve can be cut out.

The alternating device has proven very satisfactory in actual operation.

Albert Kahn, of Detroit, Mich., was general architect for all of the work at Langley Field and The J. G. White Engineering Corporation were the constructors. The engineering design of the sanitary sewers and disposal plant, as well as storm sewers, subsoil drainage system for flying field, waterworks and fire protection system, and industrial railroad system was carried out by the writer as designing engineer for The J. G. White Engineering Corporation.

CHARLES A. KAIN

(Continued from page 83)

He had two operations last Spring at Pittsburgh, but these failed to improve his condition. Then he went to Milwaukee and consulted a specialist, who pronounced him incurable. In hopes of relief, he went to Mery Hospital in New York City, where he died.

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PRACTICAL DRAINAGE OBSERVATIONS

(Cont. from page 77)

and hauled to the ditch by kerosene tractor and four trailers, the average haul being about 10 miles and each trip averaging about 20 tons. During the period of good dry roads, it was possible to haul as high as 30 tons, while during bad road conditions as low as 10 tons were hauled. As the ground about the ditch was wet and soft, it became necessary to rehandle the tile at the ditch-site moving them into the ditch line by means of horses and stone-boats. The tile, sizes 6" to 18" inclusive, were delivered at the railroad station in box cars and hauled to the ditch by teams, so that very little re-handling was necessary.

The cost of getting the tile from the railroad station to the ditch and distributed along the lines, averaged about 25c per ton-mile. (Team and man at the rate of \$5.00 per day).

The camp buildings consisted of two houses, built on old threshing machine trucks, and were 8' wide by 18' long. They were found to be very convenient in moving about from place to place, on the ditch, keeping centrally located with regard to the location of the crews at work.

The ditch was built by a combination of hand labor and machine work, the total average crew being about 9 men (average wage per man, including the machine operators was \$5.00 per day). The 20" to 30" tile were placed by a Dry-Land Dredge,

of the "Economy" type as manufactured at Iowa Falls, Ia., while the 6" to 18" tile were placed by a ditching machine of the wheel-excavator type, as manufactured by Pawling & Harnischfeger Company, Milwaukee. In order to speed the work along, many of the smaller tile were placed by hand labor.

Some of the marsh land, to be tiled, was under water and had to be tapped and drained before laying the tile. This caused a considerable delay on some of the lines and carried the work later into the year than was anticipated.

The Dry Land Dredge has the advantage of being turned into a back-filling machine, by turning the wheels at right angles and moving the machine along the side of the ditch, with the boom extending across the trench to the dump. The larger trenches were filled with this machine. The smaller trenches all had to be filled by team, with plow and scraper.

With an equipment out-lay of \$15,000, and a working fund sufficient to care for all repairs, pay-rolls, and contingencies, for three months in advance, it is possible to keep two or three ditches of this size under construction.

To the engineer intending to specialize in drainage work I would suggest that he spend some time with a well established firm, in the business, before entering the field for himself. It is the writer's observation that in drainage work, as well as in other lines of industry, more failures occur as a result of inexperience than from any other cause.

THE CORNELL CIVIL ENGINEER

and

Transactions of the Association of Civil Engineers of Cornell University

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FEBRUARY, 1921

No. 5

EDITORIALS

Elections. With the graduation of Donald G. Cockcroft this January, the CIVIL ENGINEER lost a very competent leader. We all unite in taking this opportunity to wish him as great success in the school of Experience as he has had at Cornell. As a result of the election which was made necessary by his resignation, John J. Chavanne, Jr., '21, of Woodhaven, N. Y., will fill the position of Editor-in-chief instead of Alumni Editor.

The CIVIL ENGINEER takes pleasure in announcing the following elections: Robert L. Schmidt of Brooklyn, N. Y., Felix E. Spurny of Long Island City, N. Y., and Thomas B. Tyldesley of Watertown, N. Y., as members of the Sophomore Editorial Board, and Benjamin H. Palmer, Jr., as a member of the Sophomore Business Board.

Professor

Fred Asa Barnes
C. E. '97.

On February ninth the duties of the Director of the School of Civil Engineering of the new combined College of Engineering were formally assumed by Professor Fred Asa Barnes, C. E. '97. Dean Eugene Elwin Haskell, C. E. '79, has been granted a sabbatic leave for the second term of this year, at the end of which he will retire. All our alumni and present undergraduates will be sorry to learn of the retirement of Dean Haskell. His familiar "Good Morning, boys" will be missed around Lincoln Hall; but even more than that kindly expression of welcome will be missed the helping hand and good, sound advice, which he was ever willing to offer.

Only a small proportion of our undergraduates have had the opportunity to become acquainted with our new "boss," Professor Barnes. For that reason a few words about him ought to be fitting and proper at this time. In our work on the CIVIL ENGINEER we members of the Board have come into personal contact at all times with Professor Barnes, who has been our faculty advisor for the past several years. At all times has he been our guiding star. No matter how slight or serious the difficulty which might be troubling us we were always sure to find him ready and willing to help us. Under-

graduates should remember that they have one real, sincere friend in the College who is taking an interest in them, second only to that of their parents. Take advantage of every opportunity which affords itself to make the personal acquaintance of Professor Barnes, as it is something which cannot be valued too highly. The Trustees are to be congratulated on their wise selection of Professor Fred Asa Barnes as Director of the School of Civil Engineering of the College of Engineering.

The Antioch Plan.

In connection with the discussions of the subjects of a more liberal education for engineers and new methods of teaching which have appeared in recent issues of the CIVIL ENGINEER it is interesting to note in the January 20 issue of our contemporary, ENGINEERING NEWS-RECORD, an article describing the new plan of instruction to be instituted at Antioch College, Yellow Springs, Ohio. In brief, the Antioch idea is this: first, to train men and women for administrative positions rather than subordinate employment even if this be of a skilled nature; and, second, to bring this about by combining with the usual theoretical instruction, actual practice in laboratory work on an enlarged scale. The direction and management of campus industries, for instance, will afford this practice. Both liberal arts and technical courses are to be given, and the student taking the co-operative schedule of both work and study will normally require six years to complete the course, while one taking the study alone may finish in four years.

The plan is novel and has the support of many eminent engineers and scholars throughout the country. A college is frequently likened to a factory—a factory requiring four years to turn out its finished product in the form of what really is a machine-developed student. Too often is this the case; and especially in large universities do the great mass of students graduate with nothing of the individuality and initiative which are so necessary to success in later years. Practice in executive positions in different campus industries will tend to develop a man along these lines and give him the power of

quick perception and sound judgment. The business of organization and management is an art in itself and combined with the knowledge obtained in the classroom, spells success.

There are two ways of reaching the top of an organization: first, by burrowing up from the bottom, and, second, by going over the top, i. e., starting as the head of a small unit and gradually advancing from the head of one organization to the top of a larger one. The prime difference lies right here. The first method of achieving success is a slow, life-long job and comes as a result of faithfulness and experience in that particular line of work. The second method is much more agreeable and rapid. Advancement in the latter case comes as a reward of knowledge plus ability plus experience. It is for this latter form of advancement that Antioch College will prepare its students.

One fact, however, should be kept in mind. Some men are born leaders and through personality and initiative assume their positions of leadership in life, whether they are previously trained in colleges or not. Others will never develop the necessary requirements regardless of training.

The Antioch Plan which will be given a practical trial beginning next fall will undoubtedly be watched with much interest, and its future success will depend on the results obtained in the next few years.

Just before and after every set of Final Examinations we inevitably have the same heated discussion on establishing an honor system in the University. And just as regularly as it has been started, it has been stopped a few days after the smoke of battle has been cleared away. But this year we seem to have got a little more advanced than usual, and here's hoping we will see it through to a finish this time.

As a result of the recent agitation a vote was taken at the time of registration for the second term. This vote showed a proportion of ten to one in favor of an honor system, and most of the few who voted against it included with their vote the remark that they would be in favor of a system which would work satisfactorily. Just what do these results indicate? They seem to show conclusively that the undergraduate body is becoming tired of being treated like a bunch of convicts in examinations in which the Faculty members act as "cops."

But does that mean that we are ready to go ahead and establish a system of student self-government in examinations? Some will say: "Why not? The Faculty and students have both voted in favor of it. So let's have it." We can think of no better answer to this statement than to repeat the remark of Dexter S. Kimball, our Dean. He says, "Develop an honor sentiment, before you develop an honor system."

The **Cornell Daily Sun** and the **Cornell Era**, in recent articles and editorials, have pointed to the College of Civil Engineering among others as having a successful honor system. Unfortunately, we must take exception to this undue praise. The Civil Engineering honor system has not worked in spite of the fact that the student committee recently expelled four men for fraud in exams. Time and again students have been heard to say, "I saw plenty of cribbing going on, but I'm not a 'squealer.' " They take that attitude because they have not got the proper spirit, and until we teach them the harm they are doing by not reporting such incidents to the Student Committee, we can not hope for a successful system.

Let's move slowly but surely, because we do not want to start anything that will bring discredit upon the University. After we have found the man or group of men big enough to instill the honor sentiment into all of us, then, but not until then, do we want an honor system.

In this issue is a short report on the financial condition of the Cornell Civil Engineer. The purpose of this statement in the middle of our fiscal year is to set forth the amount owed us by delinquent subscribers. At the present time we have \$1,500 owed us for both last year and this year by men who are still receiving their issues. This does not include an item of nearly \$2,000 owed us on old accounts. After making numerous efforts to collect this latter sum, we have transferred it to a bad debts account.

We realize that our subscribers are busy and that it is merely an oversight that these accounts have not been paid. These subscribers do not intend to disregard it but only defer payment until they have more time. The result is that every year we receive about 70% of the money that is owed us for current subscriptions.

At this time we are sending out bills to all these delinquent subscribers. We do not want any such response as we had in November when we sent out bills amounting to \$1,500 and received \$400. This did not give us sufficient working surplus to meet our own bills which come due monthly. Most of our bills are contracted with the usual discount of 2% for cash within ten days. If the CIVIL ENGINEER were in a position to take advantage of this discount, it would affect a considerable saving. However with so many outstanding accounts we are obliged to let this ready cash slip through our fingers.

If everybody would bear in mind that he is preventing us from improving HIS magazine, when he does not pay his overdue subscription, there would be no need of further complaint on this score. All subscriptions are payable in advance, and we will appreciate a prompt settlement of these accounts.

SHEET PILES*

By FRANK W. SKINNER, C. E., 79, Consulting Engineer
Associate Editor, *PUBLIC WORKS*

The Advantages and Disadvantages of the Various Kinds of Sheet Piles and the Methods of Driving Each Type.

Several years ago the writer was requested by the engineering department of an organization that extensively manufactured construction plant equipment, to design a steel sheet pile to compete with those already on the market. The problem was handled as a synthetic proposition commencing with a careful study of all the principal requirements for a steel pile and their relative importance; existing piles were compared with a theoretical standard and with each other and their advantages and defects were noted. From a comparison of these investigations general requirements were framed to which the new pile should conform with consideration of the points to be adapted or improved and of those to be avoided.

The general conclusions were that the steel piles then on the market together afforded the following advantages which however were not all possessed by any single type: they could be made of any length. They possessed very strong positive interlocks. They could be made in two or three widths and each width could be varied about $\frac{1}{2}$ inch in thickness. They could endure very severe driving. They could penetrate very hard material and displace many obstructions. They could under favorable circumstances be pulled and redriven repeatedly. They could be used where wooden sheet piles could not be used.

The principal faults and objections were: they could not be made light enough to justify their use for temporary or unimportant use. The metal in them was not disposed so as to give a high section modulus. A great increase of weight produced a comparatively small increase of strength. The sizes were rigidly confined to a very few widths. The cross-section could not be modified to suit varying conditions or requirements. The types possessed no flexibility to adapt them for economical conditions. None of them provided a water tight joint. The great weight made heavy first cost, freight and transportation charges. The great weight made them difficult to handle and required power for assembling them. They were seldom adapted to be driven by hand, even under the most favorable circumstances. They were not wide enough, thin enough, or light enough, for economical installation in very soft wet ground. They afforded

the engineer or contractor very little choice of type or size. The telescopic installation joint required a head room of twice the length of the pile for assembling. Their manufacture was restricted to a single mill for each type where special rolls were maintained for the entire tonnage of that sort.

Sheet Pile Essentials

The requirements selected for the best possible type of steel sheet pile were: adaptability for varying conditions and requirements. Variation in the character of the cross-section. Unlimited range of width, thickness, weight and strength. A simple, positive, efficient interlock, standard for all types of units. An interlock absolutely water tight under moderate pressures in clear water. Adjustability of interlock. Most efficient and economical distribution of metal. Facility of driving. Ability to endure severe driving. Ability to penetrate hard ground. Ability to encounter obstacles without destruction. Ability to be driven under unfavorable conditions entirely without injury if necessary. Standard provisions for corners, intersections and the like. Use of the cheapest, strongest and most easily and universally obtained steel. Low cost of manufacture. Low cost of installation. Minimum cost of transportation and handling. Complete change of dimensions and even shape of cross-section without radical change in fabrication, thus making it feasible to adjust the design to the requirements, providing accurately for special conditions and enabling the piles to be supplied at short notice from raw material in stock.

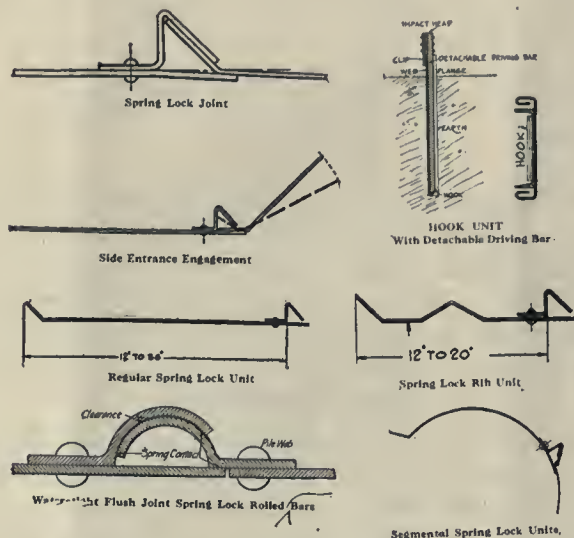
Original Spring Lock Joint

Practical considerations eliminated rolled sections and the first solution was obtained by designing a simple, improved, universal installation joint that could be applied to a pile unit of any weight, strength, dimension or cross-section, including standard structural shapes.

With this end in view the spring lock joint was designed to be formed cold on the longitudinal edge of the steel plate or sheet unit or to be made on a separate bar and riveted to the unit. The lock consists of two bent flanges held in engagement by a projecting edge of the web plate or equivalent part of the pile unit. The relatively light narrow joint bars correspond to connection angles and can be mechanically treated as such, so that it is an easy matter to provide two or three sizes and several thicknesses, adequate for all kinds of varying condi-

*Illustrations reprinted from special articles by the author, published in *PUBLIC WORKS* December 18-25, 1920, and January 8, 1921.

tions and keep them in stock to be attached to any type or dimension of pile unit selected for special occasions.



Details of Spring Lock Joints and Pile Units

The joint bars can be proportioned with or without clearance, and the clearance can be easily adjusted to make a loose joint or to provide spring contacts throughout the full length, affording a connection water-tight under moderate pressure. This clearance can be easily increased or diminished at will, even by sledging or cold bending in the field so that the piles can be quickly adapted to changed conditions after they are fabricated.

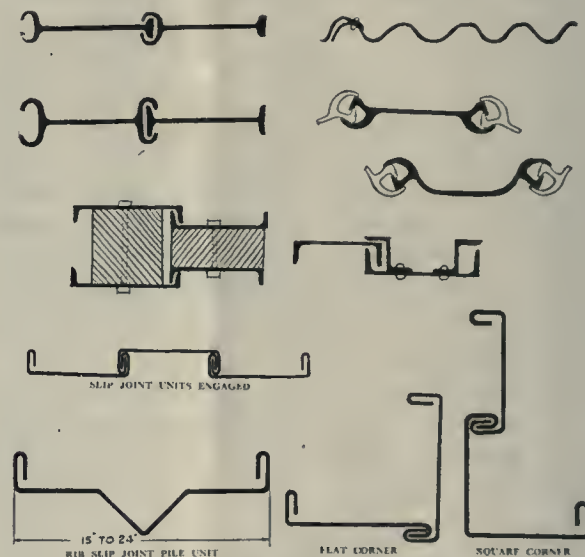
At first the joint bars were rolled with segmental flanges usually 1-4 inch in thickness, and then riveted to the web plates of the pile units, thus concentrating a considerable part of the metal at a distance from the neutral axis, making a stiff section comparable to that of a channel bar, and having a good section modulus. The joint bars could be rolled of any thickness at the rolling mill and shipped to any point where it was desired to rivet them to any type of web unit selected. Later it was found convenient to make the joint bars of sheet metal and rivet them on, or to form them integral with the edges of the pile unit webs, processes that greatly expedited and cheapened the manufacture and made it easy to give any required dimensions to the joint bars themselves, thus permitting them to be made deep and give extraordinary stiffness to the pile units when required.

The reversal of the male bar in the joint or a modification of it, making it correspond more closely with an ordinary structural angle, allows the engagement of the installation joint to be made from the side, in the full length of the joint at one operation, thus permitting two engaging units to be assembled together side by side and reducing the headroom necessary for it to the exact length of the pile itself, an extremely important feature not possessed by other piles.

The simplest spring-lock pile unit consists of a flat plate or sheet with a male joint bar on one edge and a female bar on the other edge. The width thickness and length of the web plate being of any required dimension, usually of a minimum of 6 inches wide and 1-16 inch thick for hand driving. The thickness may be increased to any required amount according to the difficulty of driving, the obstructions encountered, extra heavy strength or durability required. For ordinary purposes the dimensions vary from 12 to 20 inches wide x 1-16 to 1-2 inch thick. For installation in very soft mud or where the piles can be assembled and placed and do not require driving, the width can be increased indefinitely up to perhaps the limit of shipment.

It is obviously easy to produce numerous modifications of the unit by stiffening the web with reinforcement angles or other forms of ribs, or by bending it.

Very great success was obtained by bending it to a segmental cross-section with versed sine of 2 to 6 inches according to the width, thus making units which readily assembled into perfect cylinders, water-tight if required, and notably adapted for cofferdams, bridge piers and the like. By revers-



Principal Types of Steel Sheet Piles

ing alternate units a corrugated effect was secured with tremendous bending strength far exceeding that of any other pile type.

Slip Joint Piles

After spring-locks and sheet piles had been fabricated in bridge shops and other shops having riveting and shearing facilities it was found that for small amounts or intermittent work, the price of riveting was too high, and in the special effort to eliminate it the writer devised the slip joint pile which is merely a sheet metal channel shaped unit with double flanges which is believed to afford ultimate simplicity and economy of construction with great flexibility of detail and high efficiency, making

it available for a very wide range of use. The ordinary dimensions vary from 6 to 16 inches in width with flanges from 1 1/4 to 2 1/2 inches, thicknesses of 1/16 inch to 1/8 inch, weight varying from about 3 to 9 pounds per square foot, and strength far in excess of any other type of pile of the same weight.

The interlock is the most positive, complete, and far the strongest that has yet been devised and all of the material in it is efficient without involving any extra thickness or inert metal although every part of the joint metal is so placed as to have the maximum effect for stiffening the pile unit. The piles are much lighter and stiffer than 2 or 3 inch planks of the same width. They penetrate ordinary soil with great ease, cutting like a knife edge, and for moderate lengths, can be assembled and driven by hand under ordinary circumstances. For large work, long piles, or harder driving, they are very advantageously installed with a light air hammer or with a hydraulic jet or both, according to conditions.

When made of thin metal, up to 16 feet long, they can be fabricated in large quantities at the rate of 1,000 to 1,500 square feet in eight hours by two men with a 16 foot long, power driven, bending brake. And this cost, plus the cost of the sheets cut to order at the mill, and the freight on the same, is the total direct cost of production, thus making the actual cost only a fraction of the price of the lightest and cheapest rolled piles, which are not nearly as desirable for many kinds of light work. Of course the wider and the longer the units are up to the given limit, the cheaper is the fabrication per square foot, although it is slightly greater per linear foot.

There is no additional trouble or expense caused by varying the width or length of the piles or the width of the flange, or of varying the thickness of the web except as the thicker webs are harder to bend. They can therefore be made without extra cost with any dimensions best suited for the required strength and for the conditions of driving provided the material is ordered at the mills of the correct size to avoid waste and re-cutting. The sheets can be purchased at any sheet mill, shipped at a minimum freight cost and fabricated on the job or at any point where the simple and comparatively inexpensive bending machine is installed.

These piles are especially desirable for sheeting sewer, water pipe, gas pipe and conduit trenches, for cellar excavations and all kinds of land cofferdams of moderate height. For ordinary trench work they can be driven well by hand and for large jobs standard air hammers can be advantageously used and in silt, loam, mud and sand or ordinarily free soil, piles from 6 to 9 inches wide can be driven to a penetration of 5 or 10 feet by hand and piles up to 15 inches wide and 16 feet long can be driven

on the same conditions by air hammers and with webs of about No. 12 or 15 gauge can be driven to a penetration of 15 feet with air hammers without any other apparatus.

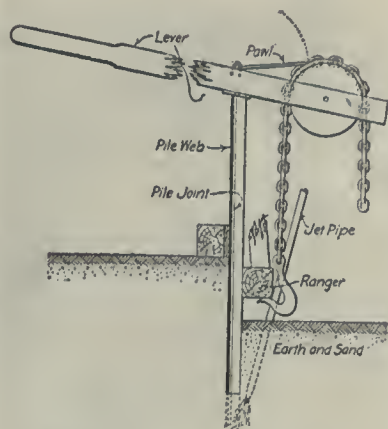


Driving Steel Sheet Piles with Hammer in Leads Suspended from Gin Pole.

Special Driving

For long lengths or hard driving the author's detachable driving bars can be used to great advantage with both the spring lock and the slip joint piles. If there is any possibility of hard driving being encountered it is desirable to bend the last 2 inches of the sheet pile web at both ends back on itself through an arc of 180 degrees, thus reinforcing it top and bottom against the hammer blows and against obstructions encountered in the ground. If it is necessary to use the driving bar the folded edge at the lower end of the pile is spread open to a V shape to receive the lower edge of the driving bar which is bevelled to almost a cutting edge and closely engages it.

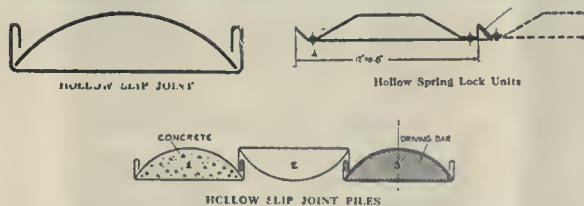
The driving bar is of wood or steel, as wide as will fit between the flanges of the sheet-pile, and a little longer than the pile. An ordinary channel bar is very suitable for this purpose. After the lower end of the driving bar is engaged in the hook



Driving Spring Lock Wide Unit Piles Without Impact.

at the bottom of the sheet pile, the upper end is clamped or bolted to the pile and the pile unit being engaged with the adjacent one, the hammer is operated on the top of the driving bar and the latter, protected by the hook on the bottom of the pile, is forced through the ground and through obstructions, backing up the thin metal so well that the latter is uninjured and serves to protect the driving bar itself.

The pile unit is thus pulled down and is under tension only, without impact or compression, thus enabling it to be installed without injury under very difficult conditions. After the pile is driven to the required penetration the driving bar is very easily withdrawn and applied to the next unit, which is driven, and so on, one driving bar being sufficient for a great number of pile units. By this means wide and very thin pile units can be driven and installed in perfect condition, even where the ground is hard or obstructions are encountered.



Thin Hollow Sheet Piles of Simple Types.

Hollow Sheet Piles

Very light and strong hollow piles with spring lock joints can be advantageously made by one flat sheet and one bent sheet with spring lock elements bent on their edges and riveted together as shown in the cross section. The fabrication is a little simpler if the flat sheet has one bend and all the other bends are in the other sheet as indicated, but as it is difficult to bend very heavy metal this probably limits the thickness of the flat sheet to about 1-8 inch un-

der ordinary conditions. Even with a thickness of 1-16 inch for both sheets, a very light and exceedingly strong pile is secured but if greater strength or thickness is desired the flat plate may be entirely flat and of any required thickness and all of the bends may be made in the other sheet with a maximum thickness of 1-8 inch or less. The bottom of the flat plate should be bent up to make a hook to engage the lower end of an inside driving bar with which the pile should be installed.

Hollow piles are still more cheaply and simply fabricated with the slip joint unit. In this case it is only necessary to curve a segmental plate to an arc having a chord just a trifle longer than the width of the slip joint unit. The edges of this segmental sheet are then sprung together so that they may be entered between the flanges of the slip joint unit and when released they spring tightly into position as shown in the cross-section. The friction and pressure will hold the two pieces firmly in position, but additional assurance can be attained by bending the flanges of the slip joint slightly more than 90 degrees. These, like the spring lock piles, should be driven with an interior driving bar, and like the latter can be given almost any required independent strength or may be still farther strengthened and given much more solidity by filling them with concrete in which reinforcement bars can be placed if required.

Miscellaneous Types of Sheet Piles

Numerous types of sheet piles with a great variety of cross-sections and wide variation in the character of the installation joints, have been designed in this country and in Europe, particularly in England and Germany. Many of them have been patented, but a large proportion of them are impracticable for various reasons, some of them have never been used at all, and most of them have not been successfully or extensively installed.

They have been designed of wood, of concrete, of cast iron, and of rolled or fabricated steel and with combinations of these materials. Some of them have engaging parts that form an installation joint without an interlock; some are difficult or costly to manufacture; and some are difficult to install. At present less than half a dozen distinct types are in general use in this country. A very large proportion of tonnage installed weighs from 30 to 45 pounds per square foot and were rolled units for which an allowance of \$1.00 or more per square foot was usually estimated, before the war, in contract bids.

The simplest of all sheet piles obviously consists of a square-edge wooden plank 1-inch or more in thickness which cannot of course give water tight joints and can seldom be driven with accuracy. It often however suffices for a small amount of work, for temporary construction, or easy conditions in



Driving Wooden Sheet Piles for Foundation Pit of New York County Court House.

dry ground, especially where it is only driven as the excavation advances or can be put in place after the excavation is completed. The lower ends should be bevelled to make them draw up against the last driven unit and like all other sheet piles, they should be driven between pairs of rangers, keeping them in alignment and should be maintained plumb.

If wooden sheet piles are 2 inches or more in thickness they may have tongue and groove joints, that if perfectly installed are water-tight, but do not provide any interlock nor possess much joint strength. For thick units it is more economical and efficient to replace the tongues with splines fitted into one of the units before driving. Tongue and groove joints may be provided by composite units made by bolting together three thicknesses of duplicate planks with one edge of the center plank projecting beyond the edges of the outside planks as in the Wakefield sheet pile, or by nailing splines to the edges of the unit to form tongue and groove. If the splines are beveled they may give a dove-tail arrangement that provides a sort of interlock.

Combination piles are made by bolting pairs of channels alternately back to back and reverse, with

full length wooden fillers of two different thicknesses, thus providing male and female units that can be made of standard structural material which yield almost 100 per cent salvage. They are however expensive and hard to drive.

The United States Steel Sheet piles are rolled sections having a female joint member composed of a pair of curved jaws and a tee-shaped male member. The loose joints are sometimes splined or filled with cement or puddle to make them tight.

Lackawanna sheet piles have straight or arched webs with duplicate joints on each side, that in engagement, form double knuckles, and possess considerable bending strength. The Wemlinger pile is simply a rolled sheet with extra wide and deep corrugations. Adjacent units are engaged through installation joints made by short or full length cover strips riveted over one of the corrugations. Difficulty is experienced in driving and pulling the piles under unfavorable conditions.

One of the oldest types of these sheet piles is the Friedstedt pile made of channels and Z-bars riveted together and having a large section modulus.

Concrete Sheet Piles

The use of concrete sheet piles although still remarkably little exploited and developed, is potential of great economies and other advantages for many important purposes where they can replace much more costly masonry and eliminate slow and sometimes dangerous construction methods. The general features were discussed by the writer in a



Driving Steel Sheet Piles in Foundation Pit of New York County Court House.

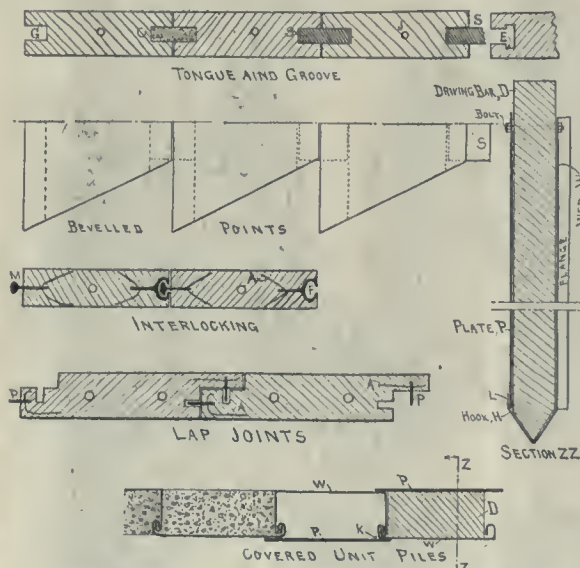
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Where permanent sheeting is required steel and wooden sheet piles, especially those with thin webs are often objectionable because of their liability to deterioration and ultimate failure to which concrete piles are not subject.

Long concrete piles need reinforcement in order to enable them to be handled with safety if they are of the precast type. If they are of the cast-in-place type they will not need reinforcement unless it is requisite to give them the necessary section modulus.

Where sheeting is used to retain the sides of excavations or where it is important to prevent any bleeding, displacement, or settlement of the adjacent soil as is often the case in trench work in city streets or in excavations close to important foundations or other substructures in quicksand or treacherous soil, or where the sheeting can not be removed after the excavation is back-filled on account of displacement occasioned by the movement of the soil to fill up the voids left by its withdrawal, concrete piles would often be suitable and sometimes as cheap or cheaper than satisfactory wood or steel.

In other cases such as bulkhead, wing, abutment, and retaining walls, thick concrete piles forming a continuous permanent structure possess the very great advantage of being installed without the expense or delay of excavation, pumping or bracing and may often be advantageously substituted for some other specified type of construction.



Concrete Precast and Cast-in-Place Sheet Piles.

Precast concrete sheet piles have been successfully used in a number of cases but they were generally of large dimensions involving considerable cost in casting and handling and very heavy and expensive driving. When the driving is hard it im-

poses very heavy impact on the concrete which is objected to by many engineers and requires powerful steam hammers. This trouble may be avoided by concreting the piles in place by methods that have been perfected but have been little used for this purpose. These methods require the same plant and operations as are used for precast piles and for preliminary work, and have the advantages of economy and of eliminating positive imperfections and uncertainty of conditions, of the finished construction.



Driving Trench Piles with Steam Hammer Suspended from Gantry Traveler.

tion. In both cases ordinary standard hammers or hydraulic jets are used.

Tongue and Groove Piles

The tongue and groove type is the simplest of precast piles and may be made with the tongues integral with the piles, or, more advantageously, with each unit provided with two grooves G and one wooden spline S. After driving the splines may remain permanently in position or they may be withdrawn and the grooves they occupied may be filled with concrete, C, uniting adjacent units. If desirable to provide a positive interlock the inner ends of the grooves may be enlarged by lateral extensions E of the grooves G, which will hold the concrete in position.

The bottoms of the pile units should be bevelled

(Continued on page 103)

PROFESSIONAL EFFICIENCY OF THE EMPLOYEE*

By A. W. BERRESFORD, '93

Pres. of A. I. E. E. and Gen. Mgr. of Cutler Hammer Mfg. Co.

Some Good, Sound Advice, Beneficial Especially to the Young Engineer and Interesting to All.

Efficiency per se is a ratio—absolute efficiency being the ratio between that attained and that ultimately possible. Efficiency as applied to the man is a loosely used term, being largely employed in connection with the “getter of results,” even though his processes may be the reverse of efficient and his success due either to marked personal ability or exceptional opportunity.

Efficiency, as such, however, is still a ratio and personal efficiency may be represented as a fraction in which the numerator is a man's developed capacity and the denominator his ultimate productive capacity.

To translate efficiency as so represented into a real quantity and not merely a relation, it is necessary to multiply “opportunity” by the percentage exhibited, the product being “results.”

From this viewpoint it might seem that the results accomplished would vary only directly as the “developed capacity” of a man, but this is not the fact, since to increased capacity (or efficiency) the tendency is almost irresistible to accord increased opportunity, so that results increase in greater ratio than either, and results mark a man's standing with reference to his fellows.

Assuming, therefore, a given ultimate capacity inherent in each of us—and differing in each of us—which is bounded by our natural limitations, the importance of increasing the numerator of the fraction (developed capacity) becomes immediately evident if we are to have the advantages resultant on increased opportunity.

There are three factors in “developed capacity,” namely, knowledge, judgment and a constant and intelligent use of both.

Considering the last one first. To use anything or to do anything implies a time factor. We each have in each year 365 days of twenty-four hours each to dispose of. It would be a mistake to endeavor to use too great a proportion of these in sustained effort. Let us assume 2,400 working hours for the year, or 8 hours for each of 300 working days. Other things being equal, if every man but one wastes, intentionally or unintentionally, one of these hours each day, then that one man has a “developed capacity” 14% in excess of the others, and, theoretically, is entitled to, and, as a matter of tendency, will receive at least 14% additional opportunity. 14% increased capacity multiplied by 14% increased opportunity equals 30% increased results,

and that should mark the relative value of that man compared with his fellows.

Unfortunately, or fortunately, other things are not equal, and one man's ultimate capacity exceeds that of some other. If he is content to let his “developed capacity” remain at a lower relative level than that of the man not so highly endowed, he may still pull through in the ruck, but look what he is throwing away. And at that the chances are against him, in that a habit of partial neglect—a letting of well enough alone—is just as definitely a growing thing as a habit of industry, and it does not always, or even usually, stop at the point planned.

In any event, the illustration makes clear the value of the proper use of time and the most valuable single factor in its proper use in concentration. When you do a thing, do that one thing, and while you are doing it, do that thing only. If you work, work. If you play, play. Don't mix the two and don't do either without definite intention.

We all of us have the mind-straying tendency. We are engaged in one thing and something distracts and for an interval—perhaps only an instant—we let that something come in between us and what we are doing. If we let this happen for one minute in each eight minutes, we have wasted the one hour out of the theoretical eight which we allowed ourselves.

I do not mean by this that if a thought comes which may really be of value it must be forced out of the mind. I refer to the extraneous unimportant matter which obtrudes, or to which the mind, unless controlled, seems certain to wander. If a valuable thought comes, consider it long enough to determine whether to concentrate on that, or on what you had been doing, and then concentrate. By constant effort you can acquire a habit of mind which will be automatic in its operation. You will be able to handle the various matters on which you may be engaged as if each were an actual physical body, setting them aside totally as necessity may dictate and picking them up an hour or a day later fully in hand and ready to start at full speed where you left off. Extraneous happenings will not distract you and you will be as little disturbed by your surroundings as if you were alone in a noise-proof vault, and—here is the big point—while you are working you will be giving all that is in you to the mum in the time available.

A factor of importance only secondary to concentration in the economy of time and consequent increase of developed capacity is the proper distribution of time.

* Speech made before the young engineers of the Cutler Hammer Mfg. Co.

If you are an engineer, you will know at a certain time each day approximately what will lie before you—barring the unexpected—and can plan your time so as best to accomplish it. If you have one problem which will require half of your day and a dozen others which, together, will occupy the remainder, all of them of approximately equal urgency and all requiring the writing of letters you will obviously run a better chance of cleaning up that day if you straighten out the dozen and dictate these letters so that the stenographer may type them while you are attacking the long one. An obvious process and only an illustration, but the habit of planning work produces results. It is surprisingly frequent in its absence.

If you are a salesman and do not plan definitely your day's trip, determining in advance wherever possible that you will find the man you want to see, or an acceptable substitute, and grouping your calls so that you spend the maximum possible percentage of your time face to face with your customer, you are not increasing your "developed capacity," and you are wasting your time and our money and reducing our chance of getting business. If you spend an hour going and coming and don't see your man, you lose and we lose, since you might have been doing something productive. If you spend that hour going and coming and twenty minutes more waiting for your man and then get a ten minute interview, even if successful, you have worked effectively only ten minutes out of ninety whereas by planning you might have run over there yesterday when you were only ten minutes off, prearranged your appointment and been working effectively ten minutes out of twenty. The out and back trip without appointment is necessary many times, but not as many times as it is made.

Of equal importance in increasing the numerator of the fraction is the skillful use of time. I assume that you have learned the lesson of concentration.

If, as an engineer, you are going into a conference,—know your subject. Consider it sufficiently carefully yourself in advance to have an opinion and be prepared to state the facts on which you base that opinion. It may prevail, or you may have to change it. That is the purpose of the conference, but you have no right in the ordinary case to do your thinking after you get there. You waste other men's time and you enter the conference in a wrong mental attitude. Your opinion is of less value and you have not contributed what you could and should.

If, as a salesman, you are to interview a customer—know your subject. If you do not, you cannot answer satisfactorily the natural inquiries, nor can you put a convincing case. You will not render, either to him or to us, the service we have the right to expect. The only time you have to get results is when you are face to face with him and you have no right to waste his time or ours and you are hurting yourself if you do it.

A clean-cut mental analysis of just what you wish to accomplish either as engineer or salesman, and how you expect to accomplish it, will surely result in your time being skillfully and most effectively employed.

Again reverting to that numerator and considering the factor first named—knowledge—the part that it plays is obvious. Knowledge of the goods, of the shop, of the Company personnel affecting the specific proposition, of the customer, his need, his connections, of the competition, their apparatus, connections and method—get it—get it by study—by question—by experience—by experiment, but get it. You will need it and when you most need it the time will come when you haven't just what you want. But you reduce this chance by getting all you can as you go.

Then the factor judgment, than which there is none more important. Judgment is knowledge and experience intelligently and rightly applied. Knowledge you can acquire more rapidly than experience, but unless intelligently employed, it is of no particular value in producing results. Assuming intelligent application, your judgment will grow in direct proportion as you obtain and intelligently apply experience—no faster. And experience is, in effect, simply a sense of perspective—the passing through a series of happenings which equated to their real value and placed in the mental storehouse for use on occasion, enables us to see things in their right proportion in whatever relation they be presented. It is no mere analysis, nor the ability to analyze. Any analyst, however inexperienced, can perceive the forces acting on a point; can say one is pulling this way and another that, but to estimate the magnitude of these forces and determine how great and in what direction and how far the point will move under their influence requires a sense of proportion beyond mere analysis. An inexperienced salesman says General Electric is pulling this way, Westinghouse that and E. C. & M. another. The experienced salesman can weigh the pull, analyze into its components and apply his effort to counteract and overcome the resultant.

This, we cannot give you. Each man must acquire it for himself in order that it may be instinctive when the time arrives to use it skillfully and intelligently. The older men will coach you as they can on the specific proposition before you, but in the end you must make your own decision; try your own experiments; build up your own experience. The habit of concentration, of proper planning and skillful use of time, the knowledge you acquire and its intelligent application will all help in the acquisition of experience, and together will build up the numerator of the efficiency fraction and win for you the opportunities that make for results and progress,—for you and for us. You will work no harder but you will produce more.

THE ENGINEERING FIELD OF FIRE INSURANCE

By A. C. HUSTON, C. E., '05
Office Engineer, National Board of Fire Underwriters.

A Comparatively New Field of Endeavor for Engineers, Which, Besides Being Useful, Offers a Fair Compensation.

In a recent conversation, an official of a fire insurance company remarked that in his department, the duties of which consisted of the supervision over the writing of insurance on risks involving special hazards, he was employing only engineering graduates. He further remarked it was becoming more and more evident that the training received in an engineering course, especially that which made a man want to investigate to the bottom of a subject, was receiving greater recognition in the administrative ends of fire insurance. It is notable that the recently elected president of the Continental Insurance Company, Mr. J. E. Lopez, can boast the degree of C. E. and had his early training in railroad and Mississippi river levee work.

With the introduction of engineers into fire insurance work there has opened up a new field which, for lack of a better term, has become known as Insurance Engineering. Probably the truer term would be the old one of Civil Engineer, as in no other line of work is there the same need of wide and varied knowledge as in the fire insurance field. A good Insurance Engineer must be well up in modern hydraulic, mechanical, electrical, chemical and general industrial subjects. Usually, as in other lines of engineering, he will specialize on one or more subjects, but a general knowledge is essential for success.

The approach to fire insurance as a business is possible in several ways. In each state and each large city there is usually a board or bureau; this board or bureau specializes in inspections of risks—buildings and contents—and in the general supervision of the fire protection provided for the risk. This last not only includes recommendations for fire equipment, sprinklers and other protective devices, but also improvements to the building to make it more fire safe and to eliminate the life hazard to occupants. There is also the question of eliminating the special hazards incident to the business conducted. Employees of the bureau are usually known as inspectors; in the smaller bureaus the knowledge gained is very varied; in the larger ones, an inspector is generally held to one line of work. The next advancement depends upon the man's ability, and while it may be advancement with the bureau to a position of responsible charge in the inspection force the larger field is as special agent of a fire insurance company or an engineer for an insurance broker. Further advancement may be to most any position depending upon the ability of the individual.

Another line, following more closely straight engineering, is inspecting and reporting on municipal fire protection. The National Board of Fire Underwriters conducts such examinations on all cities of 20,000 population and over, while the bureaus maintained in the various states report upon the smaller places. These investigations require a general knowledge of hydraulics, electricity, building, construction and the more hazardous substances found in normal business, and a desire to work hard. The line of advancement from this work is to employment by a company as a special agent. A further line of advancement which will become of growing importance, is to the office of a consulting civil engineer who specializes in water supply improvements.

Engineers can often go directly into large insurance agencies or insurance brokers' offices, or into the home office of some insurance company. The first positions will be largely minor ones, often filled by non-technical men who have worked up from clerks or office boys. Taet, bearing and a desire to learn will usually give the engineer a chance to go forward. The next step is generally as special agent, which is a traveling position, and from this comes promotion to a responsible position with the company in the office.

Pay in insurance engineering is small to start with; as in all other lines of work, the young graduate must enter and compete with the non-technical employee who has been at work for two to four years and by hard knocks has become more proficient than the most learned graduate who has had no actual experience. The advancement, particularly in pay, will not be rapid nor at a high rate; in fact it is doubtful if the average pay is equal to that in many other lines of business, such as with a contracting or designing firm. The principal advantage is sureness of occupation; when other business is depressed, fire insurance must be on the alert, and in none of the panics of recent years have insurance engineers been thrown out of work. A comparison of pay with that of municipal or government work, or with railroad work, is usually favorable to insurance.

Probably the most pleasant part of insurance engineering is in the personal satisfaction of doing things for the country at large. With a yearly fire loss of about \$300,000,000 and a life loss from fire variously estimated from 10,000 to 30,000 people a year, the engineer has a wide field of usefulness.

THE CORNELL CIVIL ENGINEER

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COLLEGE NOTES

Block Week. Block Week with its attendant examinations and struggles has once more come and gone, and the second term of the year is well under way. The Board's congratulations are extended to those who are still with us, and to those who have left, the Board offers its sincere condolences and better luck in the future.

Junior Week. Junior Week, the climax of Block Week, is once more a thing of nothing more than pleasant memories. As of yore this year's Junior Week has been unanimously voted the best ever. There were several innovations tried this year which were so successful that it appears that they will be standard features of Junior Week henceforth. The first of these is the abandonment of the Sophomore Cotillion. The Glee Club as usual gave their annual concert on Wednesday night. Due to the abandonment of the Cotillon the concert was followed by several open fraternity dances. On Thursday afternoon and evening the Masque gave performances of their very successful Christmas Trip Production "Martini." Friday was taken up with skating and tobogganing parties. In the evening came the climax of the week—The Junior Prom, which lasted well on into the wee hours of the morning. Saturday morning several of the clubs served breakfasts as is their annual custom. Saturday afternoon the basketball game between the Varsity and Penn served as the chief entertainment. Following the game the newly formed Independent Association gave a tea dance in the Old Armory, which proved very successful. It is hoped that the association will continue to give such an entertainment every year. On Saturday night several of the fraternities

gave closed dances. And when Sunday night came the guests departed tired but happy, having all thoroughly enjoyed themselves.

Farmers' Week. Scarcely had the last of our Junior Week guests departed before the New York State College of Agriculture began to welcome its guests for the Fourteenth Annual Farmers' Week at Cornell. During the week of February 14 to 19 a total of 438 events were given, including lectures, demonstrations, round tables, and conferences. Fully four hundred speakers—all prominent in their special fields—addressed the meetings throughout the six days of Farmers' Week. Nearly five thousand guests were present and benefited by the talks and lectures of authorities in their special lines.

The entertainment features of the program for the week included a concert by the University Orchestra in Bailey Hall on Tuesday night, February 15; the annual Kermis play entitled "The One Way Out" written by R. B. Corbett, '22, presented on Wednesday evening, February 16; and the Eastman Stage Speaking Contest held in Bailey Hall on Friday night, February 18.

Among the prominent speakers was Professor C. H. Tuck, former head of the department of extension teaching, who has but lately returned from a five-year study of agricultural conditions in Manchuria and Northern China. Other noted speakers from outside the college staff were Dr. E. W. Castle of Harvard; former Congressman A. F. Lever, member of the Federal Farm Land Board; ex-Senator Henry M. Sage of Albany; Homer Folks of the State Charities Aid Association; Dr. C. J. Galpin of the U. S. Department of Agriculture and G. E. Hogue, State Commissioner of Agriculture.

A number of agricultural organizations make a practice of holding their annual conventions at Ithaca during Farmers' Week. This year the New York State Potato Growers' Association held its seventh annual meeting on Tuesday, February 15; the Alumni Association of the New York State College of Agriculture held its annual meeting on Thursday, February 17, as did also the Cornell Dairy Students' Association; the Community Newspaper Conference was also held on Thursday and the Rural Community Conference on Tuesday and Wednesday.

This is the fourteenth time that Farmers' Week has been a success and judging from the enthusiasm and interest of both the hosts and the guests we do not hesitate to predict that the Fifteenth Annual Farmers' Week held in 1922 will be an even greater success than this year's has been.

Varsity Basketball. After its Christmas trip the Varsity Basketball team has played a number of games and has had varying success.

Saturday, January 8, Cornell defeated Lehigh at Ithaca in a very slow game by a score of 23 to 10. Basketball relations with Syracuse were renewed with the game which was played on Tuesday, January 11, when Syracuse was defeated by a score of 24 to 13. This was the first basketball game between the up-state colleges since 1904-5 and was played before a crowd of at least three thousand. Cornell's team work and basket-shooting was superior to that of Syracuse while close guarding kept Syracuse away from the home baskets.

The basketball team broke even on a week-end trip which started on Friday, January 14, when the Varsity overwhelmed Yale by a score of 46 to 19. After defeating Yale the team made a tedious trip from New Haven to Hanover, meeting the Dartmouth players Saturday afternoon. The teams were evenly matched and although Dartmouth went ahead in the first half and assumed a lead of 13 to 8, Cornell rallied in the second period and the game stood 22 to 22 when time was called. A five-minute extra period was decided on to play off the tie in which Dartmouth gained three extra points by scoring a foul shot and a field goal. The final score stood 25 to 23.

On Wednesday night, January 19, the Varsity staged a come-back on its home court by completely outclassing the West Virginia five by a score of 47 to 19. The first half of the contest was a poor exhibition of basketball but the second period saw the Varsity exhibit more of its old time form.

On its next week-end trip to Princeton and West Point the team lost both games. The game with the Tigers was lost on Friday night, January 21, to the tune of 19 to 12. By winning this game the Orange and Black quintet evened up matters, for the Varsity had defeated Princeton on December 20 in Ith-

aca by a score of 24 to 21. In the game at West Point, Cornell led for the first few minutes of play but the Cadets then took the lead and held it throughout the whole game the final score being 29 to 20.

In its next game the Red and White five was more successful than it had been on its last trip. The University of Buffalo quintet suffered defeat at the hands of the Varsity on Wednesday night, January 26, by a score of 26 to 14. The game was loose and ragged and at times very slow. This was the last game of the first term.

The team consisting of Captain Molinet, Barkeley, Sidman, Rippe and Cornish is coached by Ortnier, '19. Molinet and Sidman both stand very high up on the list of individual scorers. Pope, Karnow, Maier and Becker of the squad are all doing good work.

At the time of going to press Cornell stands fourth in the Intercollegiate League having won three games and lost two.

Carter Elected Cross Country Captain. The election of Charles C. Carter, '22 of Rock Island, Ill., as captain of the 1921 cross country team was ratified at a recent meeting of the Major Sports Council.

The election of W. S. Dodge '22 as captain of the 1921 football team was also ratified at this meeting.

Carter has been one of the best performers for the cross country team during the past season, the outstanding feature of his record being the fine showing he made against the combined team of Oxford-Cambridge runners on December 31 at Southampton, England. He was the first Cornell man to finish and came in a hundred yards behind McInnes of Oxford, the winner. Carter ran a splendid race and finished in excellent condition. A mid-season injury prevented him from entering the Intercollegiate Cross Country run held at New Haven on Saturday, November 20. He was a member of the Cornell team that ran at the Syracuse invitation meet earlier in the season and was awarded a silver cup for making the best time in the blind handicap run. Under Coach Moakley's training much can be expected of Carter next year, for this is his first year in Varsity athletics.

Hockey. This year, for the first time since the war, Cornell again has a hockey team. The

1921 hockey team coached by Coach Bawlf opened its season on Saturday, January 15, in a game with Hamilton which was won by the visitors by a score of 2 to 0. The adverse weather conditions have not permitted any considerable hockey practice at Ithaca this year, but the team managed to get in a week's preparation before meeting the Clinton seven and its showing on the whole

(Continued on page 102)

ALUMNI NOTES

'78. Philip A. Welker has been with the U. S. Coast and Geodetic Survey for over 30 years and has had personal charge of practically all kinds of work of the Service in nearly every part of the United States, Alaska, Porto Rico, Panama, and the Philippine Islands. At present, he is Personnel Officer. His address is The Parkwood, Washington, D. C.

'97. E. T. Agate is Engineer in charge of Construction with the Hydro-Electric Power Commission, of Ontario, 190 University Ave., Toronto, Ont. His home address is Celby St., Toronto, Ontario, Canada.

'00. Squire E. Fitch has been appointed a Division Engineer of the New York State Highway Department. His home address is 33 Pearl Street, Hornell, N. Y., but he may be addressed at Albany, in care of the New York State Highway Department.

'00. James H. Miner, who is an estimator with D. P. Robinson & Co., 125 East 46th Street, New York City, gives his home address as Bellair Drive, Dobbs Ferry, N. Y.

'01. Collingwood B. Brown, who is engineering assistant of the Canadian National Railways, has changed his address to Toronto, Ontario, Canada, in care of the Canadian National Railways.

'05. Frank C. Tolles, who is general superintendent in the Bureau of Sanitation of Public Service, Akron, Ohio, has changed his address to 45 South Balch Street, Akron, Ohio.

'07. Francis W. Magdigan, who is an assistant engineer, has changed his address to 460 Maplewood Avenue, Rochester, N. Y.

'07. Donald F. McLeod is professor of municipal engineering in the University of Mississippi.

'07. A daughter, Eloise Adelaide, was born on September 27 to Mr. and Mrs. Clarence H. Swick, Capitol Heights, Md. Mr. Swick is with the U. S. Coast and Geodetic Survey, Washington, D. C.

'09. Walter Gibb is with the Shingle Leather Company, 313 Vine Street., Philadelphia, Pa., manufacturers of curried belting, and friction, hydraulic and strap leathers. His home address is 4,650 Locust Street, Philadelphia.

'09. Don O. Stone, who is maintenance engineer with the State Department of Ohio, has changed his address to 2,410 Indiana Avenue, Columbus, Ohio.

'10. Mr. and Mrs. Howard T. Critchlow announce the birth of a son, George Franklin, on October 26. Mr. Critchlow is water engineer of the State of New Jersey. Mrs. Critchlow is the daughter of Professor and Mrs. G. S. Moler, of Ithaca. They live at 577 Rutherford Avenue, Trenton, N. J.

'10. Chester H. Loveland, who is Chief Hydraulic Engineer with the California Railroad Commission, has changed his home address to 2,730 Garber St., Berkeley, California.

'11. Clarence H. Davidson, designing engineer of the Board of Public Works, of Manila, P. I., has completed a design for a new reinforced-concrete pier for Manila, which will cost about \$5,000,000. He has returned to the United States and is living at 301 E. 161st Street, New York City.

'11. Major Octave De Carre, C. A. C., has been transferred from Washington, D. C., to Fort Hancock, N. J.

'11. Rafael Gonzolez is in charge of the construction of an 800 H. P. hydro-electric plant in Cayey, P. R. He lives at 35 San Sabastian St., San Juan, P. R.

'11 CE, '12 MCE. Horace A. Vanderbeek has returned to China where he will resume his duties as dean of the department of civil engineering of the Government Institute of Technology at Shanghai.

'12. Albert B. Clunan is assistant manager of Purchases with the J. G. White Engineering Corporation; his work involves considerable knowledge of engineering as all the engineering data passes through his hands from the Engineering Dept. to the Purchasing Dept. His home address is 265 Ocean Ave., Brooklyn, N. Y.

'12. Maurice M. Wyckoff was married on June 23 to Miss Sadie Britwitz, of New York and Tampa, Fla. They are living at 1,215 Grand Concourse, New York. Mr. Wyckoff is general purchasing agent for the T. A. Gillespie and allied companies.

'13. Ernest W. Eickelberg is with the U. S. Coast and Geodetic Survey doing experimental work for the purpose of determining the intensity of gravity, the magnetic effect of the new Invar Pendulums and their constants, in the states of Wyoming, Colorado, and South Dakota; he is also in charge of primary triangulation in California and Oregon.

'13. Mr. and Mrs. Edwin F. Koester, of Wilmington, Delaware, announce the birth of a daughter, Margery, on November 19. Mr. Koester is engineer in charge of the city surveying department.

'13. Stephen H. Smith was married on August 20 to Miss Greta Victoria Jones, of Boston; their mail address is Lock Box 84, Milton, N. H. Smith is chief engineer with F. W. Jones & Company, Engineers.

'13. Charles T. Wanzer is with the Wateree Power Company, R. F. D., Longtown, S. C.

'13. Theodore L. Welles, who is construction engineer with the Crowell & Little Construction Co.,

1,931 East 57th St., Cleveland, Ohio, lives at 1,966 East Eighty-third St.

'13. Russell D. Welsh is a draftsman in charge of the Patten, Pa., office of the Pennsylvania Coal & Coke Corporation. He is supervisor of all construction work in the district comprising twenty-four mines within a radius of thirty miles from Patten. His mail address is P. O. Box 524, Patten, Pa.

'14. Albert C. Dunn, who is highway engineer with the United States Bureau of Public Roads, may be addressed to P. O. Box 415, Richmond, Va.

'14. Charles H. Fowler, who is concrete engineer with F. T. Ley Company Inc. of Fairmount, West Virginia, has changed his address to 5,500 Beverly Place, Pittsburgh, Pa.

'14. Paul L. Heslop is engaged in designing a power house and multiple arch dam at Grants Pass, Oregon.

'15. Porter V. Hanf is chief draftsman with the Southern Sierras Power Co., Riverside, California. His home address is Box 97, San Bernardino, Calif.

'15. Erich E. Schmied is designing engineer with the Morgan Engineering Company, Memphis, Tenn. He is in charge of estimates and draftsmen in the improvement of approximately 133 miles of roads in several of the road districts of Arkansas.

'15. Edward J. Thomas is an assistant in the Technical Department, of the DuPont Chemical Company, Wilmington, Del. His home address is 1002 W. Lafayette Ave., Baltimore Md.

'16. William H. Fritz, Jr., who is in the lumber business at 1,420 Chestnut St., Philadelphia, lives at Berwyn, Pa.

'16 Grad. Carlyle D. Geisler, who is a highway bridge engineer with the U. S. Bureau of Public Roads, has changed his address to the U. S. Bureau of Public Roads, Washington, D. C.

'16. Robert S. Terrance has changed his address to Industria 100, Havana, Cuba.

'17. Benjamin Friedenbergl is acting temporarily as Executive Officer of the U. S. S. Explorer at Seattle, Washington.

'17. Mr. and Mrs. Charles A. Hoffman announce the birth of a son, Charles Allan, jr., on October 23, 1920. Mrs. Hoffman was Margaret L. Chapman.

'18. They live at 153 North Fourth Street, Reading, Pa.

'17. A. R. Icasiano is project engineer for the Manila Railroad Company on the construction of the Calanag-Guinayangan Road at the Hondague, Tayabas, P. I.

'17. Gabriel E. Lund is field engineer on the construction of a sugar mill in Cayo Mambi, Cuba, for the West India Sugar Finance Corporation.

'17. A son, Peter Frederick, was born on September 1, to Mr. and Mrs. Oscar F. Priester (Helen F. Bell, '17), 2,516 Fulton Ave., Davenport, Iowa.

'17. Since his arrival in the Philippine Islands, Leroy P. Rayner has been on deep sea soundings

in the Sulu Sea, and similar soundings off the east of Luzon. He is now acting as executive officer on board the U. S. S. Pathfinder and his address is in care of the Director of Coast Surveys, Manila, P. I.

'18. A son, Charles Allan, Jr., was born on October 31, 1920, to Mr. and Mrs. Charles A. Hoffman, 153 North Fourth St., Reading, Pa.

'19. Damon Douglas is with the Turner Construction Company in New York. He lives at 17 Park Avenue, Mount Vernon, N. Y.

'19. George S. Hiscock, who is with the McClintic-Marshall Construction Co., at Pittsburgh, Pa., can be reached by addressing letters in care of Mrs. J. M. Willard, 448 Center Ave., Verona, Pa.

'20. James R. Cook is now a draughtsman with Hazen, Whipple and Fuller, of 30 East 42nd Street, New York City.

'20. Miss Olive W. Dennis is in the bridge engineering department of the Baltimore and Ohio Railroad, Baltimore, Md. She lives at 1,021 Madison Avenue.

'20. Eduard Fritz, jr., is appraiser of public utilities with Haganah and Erickson, First National Bank Building, Chicago, Ill.

'20. Bernard J. Harrison has been elected a Junior Member of the American Society of Civil Engineers.

'20. George W. Pond is in the engineering department of the Alabama Power Co., Birmingham, Ala.; he lives at 1,108 South Thirteenth St., Birmingham.

M. C. E. '20. I Hsiang Pei has been elected a Junior in the American Society of Civil Engineers. He is with the Miami Conservancy District at Dayton, Ohio.

'20. Laey L. Shirey, who is Assistant in Engineer Corps on the Cleveland, Cincinnati, Chicago & St. Louis Railroad at Indianapolis, Ind., has been elected a Junior in the American Society of Civil Engineers.

'20. Joseph A. Thomas has been elected a Junior in the American Society of Civil Engineers. His home address is Clark's Summit, Pa.

'20. A. V. D. Wallace of Goshen, N. Y., has been elected a Junior in the American Society of Civil Engineers.

M. C. E. '20. Chia T. Yeh has received a highway fellowship from the University of Michigan, and will pursue advanced study in highway transport and highway engineering at the University of Michigan until next April. Until December he was employed in the engineering department of the Tide Water Oil Company, Bayonne, N. J.

'20. Herbert H. Linnell, whose address is 19 Florentine Garden, Springfield, Mass., has been elected a Junior in the American Society of Civil Engineers.

'20. Marcus Sorokin of Russia has been elected a Junior in the American Society of Civil Engineers

THE BRIGHT SIDE OF ENGINEERING

Saying is one thing and doing is another.

On the Northwestern Railway a bridge had been destroyed by fire, and it was necessary to quickly replace it. An engineer and his staff were ordered in haste to the place to gather the necessary data and draw plans for a new bridge. Two days later came the superintendent of the division. Alighting from his private car, he encountered the old master bridge-builder of the division.

"Bill," said the superintendent—and the words quivered with energy—"I want this job rushed. Every hour's delay costs the company money. Has the bridge engineer sent you any part of the plans yet so that you can start something?"

"I don't know," said the old bridge-builder, "whether that engineer feller has the picture drawn yet or not, but the bridge is up and the trains is passin' over it."—The Iowa Engineer.

The following episode will be of interest to engineers familiar with the practice of making out reports. The author is an engineer, employed by a large manufacturing corporation, who was taken ill with appendicitis and, after surviving the customary rites guaranteed in such performance—the alienation of his appendix—dispatched this account of the circumstances to the head of his department.

Dear Boss: Arrived customer's plant Thursday the 13th. Spent day taking levels, running lines, establishing clearances, cleaning up, etc.

Friday the 14th, opened bottle of ether waves, experimented with same. Visited Mars, the Moon, Venus, etc., while Master Mechanic and pipe-fitters opened chest and looked for cracked fitting; finally found same and removed it.

Saturday the 15th and Sunday the 16th, delayed on account of trouble with pipe lines, etc.

Monday the 17th, started fires with light fuel and got steam turned on in lines.

Tuesday the 18th, general lining up, grouting, etc. Will operate on light load shortly, full load in about ten days. Work 35% completed. Did not replace defective fitting.—Wisconsin Engineer.

A surveyor was one summer tracing a township line across some farm lands in Minnesota. As chance would have it, the line passed directly through a large barn having double doors on each side of it, and they found they could continue their measurements through the barn by opening the doors and thus avoid making any difficult offsets. The owner watched their progress with considerable interest, but made no comment until they had reached the further side of the barn, when he asked:

"That a railroad ye-all surveying fer?"

"Certainly," replied the surveyor.

The farmer meditated a bit as he closed the barn doors behind them, when he remarked, somewhat aggressively, "I hain't got no objections ter havin' er railroad on my farm, but I'll be darned ef I'm goin' ter get up at all hours of the night ter open and shut them doors fer yer trains ter go through!"—The Iowa Engineer.

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Complete up-to-date records of 2,000 men are on file.

These impartial records are available to employers.

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COLLEGE NOTES

(Continued from page 97)

was creditable. Cornell played a very much better game on the defensive than on the offensive. The Varsity frequently lost the puck when within scoring distance of the Hamilton goal. The Hamilton aggregation skated well and could use their sticks better than Cornell.

The second game of the season was played on Saturday, January 22 against the University of Buffalo Hockey Team and resulted in a very easy victory for the Varsity, the score being 10 to 0. The ice was soft and covered with water but the teams were able to play through the full time of two twenty-minute periods. Young scored three goals for Cornell; Finn, Thornton and Tuttle, two; and Rollo, one. The Cornell line-up is as follows: Whitehill, goal; Young, left defense; Tuttle, right defense; Finn, left wing; Thornton, center; Barker, right wing.

On Saturday afternoon, February 12, before a crowd of 3,500 people in the New Drill Hall, the Cornell Varsity Basketball Team sent the previously undefeated Penn quintet down to defeat by a score of 20 to 19 in one of the most sensational basketball games seen in Ithaca in many years. The powerful Penn aggregation defeated the fast N. Y. U. five by a score of 24 to 11 and many believed that Cornell did not have the proverbial "prayer" against Penn. However, wonderful teamwork on the part of the Red and White and their airtight defense gave the Ithacans a very slight advantage over Penn. But the entire game, as the score would indicate, was a supreme battle for the lead which fluctuated throughout the whole contest between the two teams. Not until the final whistle of the game sounded was the outcome assured.

At the start of the game Penn ran up a lead of four points but the Red and White quickly rallied and the first half ended in an 8 to 8 tie. At no time during the second period did the lead advance by more than two points. Both teams fought and struggled valiantly to run up a safe lead but it was nip and tuck all the way with first one team ahead by one or two points and then the second tying or making a small lead of several points. Captain McNichol easily proved himself the star for the visitors by eaging nine out of twelve fouls and by getting two field goals. For Cornell, Captain Molinet threw in the winning basket from the center of the court during the last three minutes of play, besides getting another basket during the contest. Sidman, the diminutive Cornell guard, eaged eight out of eleven fouls. The other members of the team, Barkalew, Rippe, Cornish and Pope, each got one basket.

Due to its victory over Penn, Cornell, having won

three games and lost two, is now tied for second place with Dartmouth in the intercollegiate league. Columbia and Penn are tied for first place with three games and lost two, is now tied for third two games won and one lost. Any one of these four teams has a good chance for the Intercollegiate trophy.

CORNELL SOCIETY OF ENGINEERS

The Annual Dinner of the Cornell Society of Engineers was held at the Machinery Club, 50 Church Street, New York City, on January 21, 1921.

The dinner was attended by nearly 500 engineering alumni and was the biggest celebration in the history of the Society. When it is remembered that of the 1,563 members of the Society, there are but 519 resident members, it can be seen that it was truly an achievement to get an attendance of 500.

Since the former students of Sibley College were made eligible for membership, three months ago, 540 former Sibley men have joined the Society, and they were strongly represented at the dinner.

Cornell songs and good cheer were in the air, and old friendships were renewed: these are the things which always make the Annual Dinner a success and a pleasantly anticipated event.

The President of the Society, Ira W. McConnell, '97, sailed for Brazil on the 19th of January, and consequently the position of toastmaster was filled by Vice-President Henry N. Ogden, '89.

The key-note of the evening was struck by the University's President, Albert W. Smith, '78, when he talked in an inspiring way on the subject of loyalty.

Col. Arthur Woods, former Police Commissioner of New York City, was the principal speaker of the evening. He compared in an entertaining way the duties and training of the engineer and of the "Cop." The principal difference, he pointed out, was that the engineer designs and builds with materials for the safety and convenience of humanity, whereas the "Cop" works against the disturbing elements in humanity itself in the enforcement of the law, resulting in the safety of humanity. Each, he pointed out, is dependent upon the other, as bridges could not be used and the wheels in the machines in the factories could not turn without the protection afforded by the "Cop," and the "Cop" would have nothing of value to protect if it were not for the engineer.

Dean Dexter S. Kimball then pointed out the advantages which he expects will accrue from the combination of the colleges of engineering at Cornell and enlarged upon President Smith's subject of loyalty.

Dean E. E. Haskell, '79, of the College of Civil Engineering, brought with him a message from Mrs. C. L. Crandall, wife of the late Professor C. L. Crandall. The Cornell Annual Dinner would never be

complete without a message from Mrs. Crandall. She is held in higher esteem by all of the alumni than it is possible to adequately express. Professor Barnes added further references to Mrs. Crandall and assured the boys that she is still "playing the game" as pluckily as ever.

Romeyn Berry, '04, Graduate Manager Cornell University Athletic Association, then lifted the meeting out of the depths of profound idealism with his characteristic humorous offering.

It was fine to be sent home in such good humor, and his talk was a reminder that along with loyalty we must have a sense of humor to accomplish the best ultimate results.

The arrangements for the dinner were under the direction of Mr. J. D. Anderson, '10, Chairman, and it is to the energy and hard work of Mr. Anderson and his Committee that the success of the dinner was chiefly due.

SHEET PILES

(Continued from page 92)

to make them draw together in driving, and there may be one or more full length jet pipe holes J, cored in each pile unit to facilitate the use of hydraulic or pneumatic pressure in installation.

Lock Joint Piles

Precast piles may be provided with regular steel sheet pile interlocks for the installation joints. These interlocks may be of any available type and are easily and economically provided by splitting a standard steel sheet pile through the center longitudinal line, punching holes through the web of each portion, and casting the male and female elements M and F in the concrete, as indicated in the sketch, with bent anchor bars A passed through the punched holes. One sheet pile 12 inches wide will thus provide for the interlock of a concrete pile unit two or three times as wide.

Lap Joint Piles

A very simple type of concrete sheet pile is made with a ship lap joint that, if carefully installed, will serve in many cases without any method of interlocking. If it is desirable to provide a positive interlock for this type, it can be easily and cheaply accomplished by inserting full length projecting plates P, P, in the transverse and longitudinal faces of the joints to engage corresponding recesses in the adjacent units. These piles can, like most of the other types, be cast in very simple forms and have no delicate projections subject to special injury in driving. Like the other types they can be provided with jet holes and should have their lower ends bevelled to draw together in driving.

Cast-in-Place Sheet Piles

Under any conditions where it is possible to drive a rugged solid pile of the same dimensions, concrete

sheet piles can be installed by a combination of the hollow sheet pile and driving bar principles. Hollow sheet piles of either the spring lock or slip joint type, can under favorable conditions be made of any required dimensions and of extremely thin metal, even as light as 18 or 20 gauge, the limitations usually being the strength required for the projecting joint member to be safely driven. This enables the steel weight and cost to be reduced to a very small amount and permits the steel to be left permanently in the ground without involving serious expense.

The spring lock pile can be made with the end entry or the side entry joint, and with bent or rolled joint bars, the former being usually much cheaper and more convenient.

In most cases the lower end of the pile web projects beyond the flanges and is bent 180 degrees to form a hook H, or pocket engaging the lower end of a solid wood or steel driving bar D, somewhat longer than the pile unit, which receives the impact of the hammer, relieves the steel pile of all stress except tension, and is removed as soon as the pile is driven to required penetration. This provides a very substantial chisel edge that is not injured by encountering ordinary obstacles, can cut through or displace many of them without impairing the integrity of the steel pile, and is entirely independent of the subsequent concreting.

Covered Unit Piles

The covered unit type of concrete pile possesses several features of great superiority that make it convenient, economical and extremely desirable for heavy or thin sheeting where a perfectly regular flat construction of absolute uniformity and integrity is required.

For thin sheeting it is made with ordinary slip joint pile units all of which are duplicates. Each unit is driven with a driving bar D, engaging the hook bottom H, and the lip L, of the hook is extended far enough to cover the lower end of a detachable back plate P, covering the face of the driving bar opposite to the pile web W. As each successive unit is driven the web W of the slip joint pile is inserted at K between the cover plate P and the joint flange of the previously driven pile, thus making the steel construction continuous on both sides. The plate P covering the channel shaped hollow of the assembled pile makes a complete and enclosed rectangle which, after the withdrawal of the driving bar, is filled with concrete. After the concrete is set the detachable plates P, P, can be withdrawn and used again, in which case they are usually made of heavy metal, but if it desired to retain them permanently in position they may be made of very thin metal and thus reduce the cost of steel.

With this type of sheeting if the steel eventually

(Continued on page VII)

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CORNELL CIVIL ENGINEER Statement of Finances, February 1, 1921.

ASSETS.

| | | |
|-------------------------------------|----------|----------|
| Cash on hand | \$ 59.55 | |
| Alumni subs. 1919-1920 | 400.00 | |
| Alumni subs. 1920-1921 | 1,100.00 | |
| Students subs. 1920-1921 | 181.00 | |
| Advertising accts. receivable | 282.12 | 2,022.67 |

LIABILITIES.

| | | |
|-------------------------------------|--------|------------|
| Old debt to Andrus and Church | 800.00 | |
| Bills payable | 204.00 | 1,004.00 |
| Present book surplus | | \$1,018.67 |

Outlook for Remainder of the Year.

INCOME.

| | | |
|---|------------|----------|
| Advertising contracted for and payable before July 1, 1921 | Net 774.87 | 774.87 |
| Deficit | | 925.13 |
| | | 1,700.00 |

EXPENSES. ESTIMATED.

| | | |
|---------------------|----------|----------|
| Printing | 1,500.00 | |
| Miscellaneous | 200.00 | 1,700.00 |

SUMMARY.

| | | |
|---------------------------------------|------------|----------|
| Present book surplus | \$1,018.67 | |
| Estimated deficit, rest of year | 925.13 | |
| Estimated surplus July 1, 1921 | | \$ 93.54 |

SHEET PILES

(Continued from page 103)

disappears entirely through corrosion, the integrity, of the sheeting will be in no way impaired except by the negligible loss of the interlock which is chiefly necessary for installation purposes.

The rights to use the patented slip joint, spring lock joint and driving bar features are easily obtained and the steel piles, weighing, according to

width, 3 pounds or even less per square foot of web, can be fabricated from standard commercial sheets at any place where a bending brake of adequate capacity is available, by two or three men, at the rate of 50 to 400 square feet per hour, according to dimensions.

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Vol. XXIX

MARCH, 1921

No. 6

EDITORIALS

The Thesis. It is to be regretted that the thesis is a part of the curriculum of the School of Civil Engineering which is being neglected by the student body. At the time that required theses were discontinued, there was presumably no intention of curtailing commendable thesis work, but such has seemingly been the case. It would seem that in research and investigation, the School of Civil Engineering is trailing not only some of the colleges of this university but also that of many other institutions.

The field of research in Civil Engineering is wide open, and many problems are yet untouched. Mr. MacDonald, Director of the U. S. Office of Public Roads, has said that the greatest need of the country even more so than available money, in the development of our public roads to withstand modern traffic, is research. A National Highway Research Council has recently been established, and the School of Civil Engineering has been asked to help. There is abundant material for theses along lines suggested, having to do with road failures, soil bearing, effect of frost, water, and other deteriorating influences. In the field of concrete, two very recent and new methods of proportioning concrete need checking and rationalizing. A recent editorial and an article by Daniel F. Moran in the Engineering News Record call for a needed research in soil bearing and an analysis of foundation stresses. In all departments may be found subjects for investigation which would be well worth the time spent by those who undertake them. It will be found that the faculty members in the different departments are always interested and ready to aid in such investigations.

Certainly a portion of each class is fitted temperamentally and by actual liking to undertake and carry to a successful conclusion a definite problem in research or investigation. Manifestly in the thesis, perhaps more than in most of our courses, results are the primary object. The thesis, to be of value, must give results that are practical and useful, and which, if published, will be a credit to the institution and to the students concerned. Real results in an investigation are not usually secured

except after a considerable amount of independent, hard work has been done and a great deal of patience to do tedious operations has been exercised. In addition to these qualifications must be added the ability to do things with the hands or the aptitude in the actual manifestation of tools and apparatus. It is surprising how many students have not the ability to do things with the hands. Last and perhaps most important must be the ability to organize the results of the investigations in order, to point out the steps to be taken, and to draw correct conclusions from the work already done. It is plain that there is a great need for work such as the thesis affords, and that there are men in each class well qualified to carry it through.

The Committee on Research of the American Concrete Institute in its report to the recent convention gives the following subjects that need study in the field of concrete:

1. Proper methods of measuring quantities going into a batch of concrete.
2. Collection and correlation of data to show quantity of set concrete which can be made from given amounts of different aggregates.
3. Establishment of a standard screen scale for concrete aggregates and limits of variation in sizes of different classes of aggregates.
4. A standard field method for determining consistency of concrete.
5. A standard field test for strength of concrete.
6. Tests to ascertain the efficiency of various types of mixers in making concrete.
7. The allowable variations in sizings of aggregates.
8. An index of quality of aggregates as determining their value in concrete.
9. An abrasion test for gravel.
10. The production of plant-mixed aggregate.
11. A method of evaluating various forms of mechanical anchorage of reinforcing bars in reinforced-concrete beams and slabs.
12. The value of clay tile built in with concrete beams in adding to the shearing resistance of the beam.

H. H. S.

We Have with Us Again—

Professor Boothroyd, who will be remembered by all who have in the past several years taken "Prosh Surveying" as the co-perpetrator with Professor O. M. Leland, formerly of this college and now Dean of the College of Engineering and Architecture at the University of Minnesota, in the determination of the Area of Land by the method of double areas, has once more felt the lure of Cornell and will next fall return to the college and take his place in the faculty he left nine years ago this fall. Professor Boothroyd will come here to take charge of the work in Geodesy and Astronomy, and it is expected that at last the new Fuertes Observatory, a picture of which appears on the front cover, will be put to actual use. Professor Boothroyd made his first appearance in the College of Civil Engineering in the Fall of 1904, when he came here as an instructor in the department of Topography and Geodesy. In 1908 he was advanced to an assistant professor in this department, which position he held for four years. In 1912 when the post of Professor of Astronomy at the University of Washington at Seattle, Washington, became vacant he was offered the position and accepted it. Professor Boothroyd has been at the University of Washington ever since, and has gained quite a reputation in the Northwest through his work in Astronomy. He expects to leave Seattle shortly and travel about the country on business until next August when he will take up his residence in Ithaca.

It is expected that there will be several in the college who will elect work under Professor Boothroyd, as, when the courses which he expects to give were given in the past at the old observatory which stood where the New Drill Hall now stands, Astronomical Courses were quite popular. While astronomy is not an absolutely necessary adjunct to the practising Civil Engineer, a working knowledge of it often proves a very handy thing to have.

The Board of the CIVIL ENGINEER takes this opportunity to welcome Professor Boothroyd back to the college and to wish him a long and happy sojourn here.

Engineering Arguments.

A question well worthy of the consideration of engineers is: Why do engineers so frequently harbor personal feelings toward those with whom they disagree on technical matters? This would be a pertinent question to ask after nearly every meeting of engineers in which there has been sharp discussion, since personal animosities nearly always exist at such times.

We do not know whether engineers are more sensitive regarding disagreements of opinion than other classes of individuals, but we can readily see why they should be. An engineer is accustomed to dealing with facts and immutable natural laws. He feels instinctively, therefore, that there is one definite position about everything that is right and

what differs from that position is wrong. Following the natural course of the human mind, he is inclined to consider his own analysis and conclusions as correct, and, applying the rigid principle that only one position can be correct, he will at once suspect the honesty of one who advances a view which is different from his.

There is, necessarily, a right and wrong to every problem, but the difficulty is that most problems are so complex that it is impossible for us, with our feeble brains, to pick these problems apart and decide, with absolute accuracy, the value of each part and its relation to the whole problem. Even in comparatively simple cases, where it is merely a question of interpreting applicable standards, there is often a great variety of views. The reason for this is that each person is governed by his training, by his experience, and by his prejudices and there is no wonder that there are a great many different views on even simple questions.

Engineers are no exception to this fallibility of human nature. Some of their problems are subject to exact mathematical determinations, but the greater majority of them call for the application of the standards of individual experience. The engineer can be compared with the lawyer, since both must, to a great extent, base their decisions on personal experience. Engineers should, therefore, cultivate the habit of lawyers of being able to argue subjects with the utmost earnestness, and immediately afterwards hunch together on entirely friendly terms.

We must always realize that the other fellow may have as good grounds for his conclusions as we have for ours, and derive from that realization an attitude of tolerance and respect for opposing views. Above all, we must regard engineering problems as problems only and refrain, unless the grounds are appallingly clear, from imputing motives to our opponents. There should be a fair and even sharp discussion of the subject, but the personal relations should not be disturbed.

ALUMNI CORRESPONDENCE

76 William Street
New York City, N. Y.
March 1, 1921
Cornell Civil Engineer,
Ithaca, N. Y.

Dear Sir:—

It is now some fifteen years since I sat in the classroom and tried to absorb knowledge. About a year after graduation it was my intention to write an article or essay on the subject of teaching, but in this case youth hesitated to step in where mature years were leading. Since then, while not a teacher, it has been my task to break in a number of college graduates in a branch of engineering that is not covered by textbooks in an engineering course. In passing it might be well to say that this branch is

Insurance Engineering, a broad and complex compendium of all lines of engineering.

The outstanding feature of this attempt to instill knowledge, even into the trained mind of a graduate engineer, was the impossibility of doing so by means of lectures; the inaccuracies resulting were many and large and the mental training almost negligible. The only way that I found to correctly get the information to them was by written memoranda and reference to printed articles; i. e., by the use of the printed word. The printed references, while not completely covering the subject, provided a foundation on which farther information could be given by means of the spoken word or from which the beginner could reason to a correct solution of the problem in hand.

It was my good fortune to have been graduated from both Cornell and a smaller college. The methods of teaching at both schools were very different; at Cornell it was largely by lectures, while at the other it was entirely by textbooks. The result was that upon leaving Cornell, most of my textbooks, and therefore my reference books, were of an older vintage and not of that high order which they would have been if they had resulted from my stay at Cornell.

It has been claimed by some that a lecture system is necessary in higher education, as it is only in that way that the latest and most correct phase of a subject can be given to large numbers of students. Yet, in my days, typewritten copies of nearly all the lectures could be purchased at the beginning of the term and followed throughout the course. And in after years, when a more complete library was available, it was found that many of the lectures were already in book form, or the subject was very completely covered by other authors.

An outstanding example as to how best to teach is the method which combines textbooks, lectures and problems. Since the professor who used this system in one of my classes is still teaching, it may be best not to mention his name. The class was instructed to obtain and read a given book at the rate of twenty pages a day. Quizzes were given at nearly every meeting of the class testing the student's knowledge on the material in the book. But of even greater value than the quizzes were the news items read from the *ENGINEERING NEWS*, giving up-to-date data and information supplemented by problems arising or which had occurred in the professor's practice. This line of teaching fixed ideas in the minds of students, but most important of all it left him with a set of up-to-date references.

It is along this line that practical results are obtained in engineering circles; for it has been my experience that a new man entering into almost any line of engineering (and all lines are new to one who has just left college) cannot be taught by lectures. Textbooks, plans, reports and other data must be

given him in order that he may assimilate information more readily than he can from lectures. The habit of study is very important, but it cannot be obtained from a lecture course. The need of accuracy of information is essential, yet many a note book is crammed with errors, thus rendering most notebooks used in college useless in later years as works of reference. I believe that the greatest value of an education comes from knowing just where to look for information. The practice of giving lectures and taking notes does not enhance the permanent value of an education in my estimation.

Recent graduates of Cornell report that the same method of teaching is in vogue as there was in my day. It is my belief that a radical change is due. No subject should be taught in the Engineering College without a textbook to accompany it. Every important course should be accomplished by a set of lectures supplementary to the textbook given by the professor or by an expert from the outside world. This would bring into the classroom the very important and much needed elements of touch and modern application of the theory learned from the text.

The subject, of course, has two sides to it. The writer's views are those formed after several years study of his fellow students. Others undoubtedly have different views on the same subject, and it is suggested that they express their views in the Correspondence Column of the *CIVIL ENGINEER*.

Yours very truly,

A. C. Hutson, C. E. '05,
Engineer, National Board of Fire Underwriters

704 Journal Bldg.,
Albany, N. Y.,
March 10th, 1921.

The Cornell Civil Engineer,
Ithaca, N. Y.

Gentlemen:

Please find enclosed herewith check for \$2.50 to cover subscription as per statement just received.

I was glad to see in the last issue of the *CIVIL ENGINEER* a statement of the finances of the magazine. This indicates that you are not getting the support you deserve from the alumni, especially when you meet with so much difficulty in getting some of us to pay up.

This is probably nothing new to you, but it struck me rather forcibly and gave me a better understanding of your difficulties,—and at the same time a greater appreciation of what you are accomplishing.

With best wishes, I am

Very truly yours,

Arthur W. Harrington, C. E. '09,
Hydraulic Engineer.

Professor Fred Asa Barnes Appointed Director of the School of Civil Engineering, College of Engineering, Cornell University



PROFESSOR FRED ASA BARNES

Professor Fred Asa Barnes, C. E. 1897; M. C. E. 1898; Sigma Xi; Member of the Society for the Promotion of Engineering Education; Associate Member of the American Society of Civil Engineers; Member of the American Railway Engineering Association; Member of the American Association of Engineers; Honorary Member of the Cornell Society of Engineers; etc., was appointed Director of the School of Civil Engineering, College of Engineering, Cornell University, by the Board of Trustees of Cornell University at a recent meeting.

The Directors of the other Schools in the College of Engineering are as follows:

Professor Herman Diederichs, M. E. 1897, Director of the Sibley School of Mechanical Arts; Professor Alexander M. Gray, B. Sc., E. E., Director of the School of Electrical Engineering.

Professor Barnes was nominated by the Faculty of Civil Engineering to Dean Dexter S. Kimball, the head of the new College of Engineering, and the nomination was presented by him to the Board of Trustees. This procedure gave an opportunity for the faculty to select a man, with whom the faculty could work in the most harmonious feeling, and avoided the difficulties, which have arisen in many institutions, when a man from outside the faculty has been introduced, especially when this has been done against the advice of the faculty.

Fred Asa Barnes was born June 17, 1876, at Stockbridge, Berkshire County, Massachusetts. He received his early education in the public schools of Stockbridge, graduating from the Stockbridge

High School and Williams Academy in June, 1893, at the age of seventeen. He entered the College of Civil Engineering in September, 1893, and graduated with the degree of Civil Engineer in 1897. The following year he held a graduate scholarship and received the degree of Master of Civil Engineering in June, 1898.

His experience in engineering work began immediately. In the government service, he was rodman and later a draftsman in the Hydrographic Office of the Navy. Later he was Assistant Engineer under General Leonard Wood in Cuba. His work was on sewers, streets and water works; also on railroad surveys, plans and estimates for a sugar plantation and later on the same kind of work for a mining company.

He was afterward in charge of the construction of a pile and timber dock near Morro Castle, being promoted to Resident Engineer in September, 1900. Until 1902 he was engaged in various parts of Cuba on water works, bridges, mining tramways, concrete bridge foundations, and finally on surveys, plans, estimates and specifications (in Spanish) for an extensive system of water works, sewers, and surface drainage for the city of Cienfuegos.

Owing to political disturbances in the island, he returned to the United States and in 1902 began teaching as an instructor in the College of Civil Engineering. Since that time his practice has included surveys, plans, and construction of an extension of the Ithaca Street Railway system, and the layout and construction of the addition to the City of Ithaca known as the Bryant Tract.

His experience in teaching was mainly in the department of railway engineering, for many years under the charge of Professor Charles Lee Crandall. Appointed Assistant Professor in 1905 and Professor of Railroad Engineering in 1915, his work in teaching included Elementary and Advanced Surveying, Geodesy and Astronomy, Mechanics, Railroad Engineering in theory and practice, Contracts and Specifications, Cost Keeping and Management and other courses.

Alone or in conjunction with Professor Crandall he is the author of Railroad Surveying; Railroad Construction, and the section on Railroad Engineering in the American Civil Engineer's Handbook.

Long associated with Professor Crandall in all that revered man's activities, occupying part of the same office and thoroughly acquainted with the methods of dealing with students pursued by Professor Crandall, Professor Barnes brings to his new work a training and a sympathy that promise well for the success of the course in Civil Engineering. He has the confidence of Faculty, Alumni and students. He has before him great responsibilities and unusual opportunities; widening fields of interest and the pleasure of a broadened outlook. All wish for him the fullest measure of success. S. G. G.

Dean Haskell's Retirement

While the retirement of our honored Dean does not take effect till next June, his active connection with the University has now come to an end, as he has been given a leave of absence for this second term of the college year.

Eugene Elwin Haskell (C. E., and M. C. E., Cornell '79 and '90) was appointed Director of the College of Civil Engineering in June 1906. This selection was "a fitting tribute to his ability as well as a pleasing token of appreciation of his efforts for the welfare of his Alma Mater."

Previous to 1906 Dean Haskell rendered most important and successful service to the government in the work of the Mississippi River Commission and also in that of the U. S. Coast and Geodetic Survey. It was at this time that he invented the current meter that bears his name, for measuring the velocity of streams and ocean currents.

A very important later work of Dean Haskell was (1893-1906) the re-organization and direction of the U. S. Lake Survey. A most thorough study and survey was made of the hydrology of the Great Lakes Basin. The methods employed were almost wholly those originated and proposed by Mr. Haskell, who had the direction of the work from 1893 until his coming to Cornell in 1906.

During his first year at Cornell (1906-07) there appeared the first number of the Cornell Civil Engineer and the "foreword" of that issue was written by the Dean, strongly urging the support of the new undertaking. It is needless to add that during these intervening fifteen years our journal has always had his unfailing interest and support. He also showed great enthusiasm in all other college activities. At all times he urged the men to help uphold the prestige of the Civil Engineers, both on the Campus and on the Athletic Field. He has the faculty of winning his way into the hearts of all those who have reason to associate with him. Is it any wonder that he is so well liked by all the students and faculty?

But a demand for the services of our dean, after 1906, did not come from Cornell University alone. In 1906 President Roosevelt appointed him one of the three members of the American Section of the International Water Ways Commission, which was to investigate and report upon the waters adjacent to the boundary between the United States and Canada; including all the rivers draining through the Great Lakes and St. Lawrence River. After the Boundary Treaty was signed at Washington, in 1908, this commission was empowered to trace and re-establish the boundary between the United States

and Canada, through the Great Lakes and the St. Clair, Niagara and St. Lawrence Rivers. The commission finished all of its work in 1915.

During the year 1913 Dean Haskell was called several times by the United States Government as an expert witness in the suit brought by the government against the Sanitary District of Chicago,



DEAN EUGENE ELWIN HASKELL

relative to the diversion of water from Lake Michigan.

In 1915, by Order-in-Council of the Dominion of Canada, Dean Haskell was appointed as one of the three engineers of the Montreal Water Levels Commission, to investigate and report on the water levels of the St. Lawrence River from Montreal to the sea. Its work was finished in 1918.

In 1916, by appointment of the state of New York, he became a member of the Board of Consulting Engineers of the Barge Canal and is still a member of that body; while from 1914 to 1916, both inclusive, he served on the Board of Direction of the American Society of Civil Engineers.

The appointment in 1907, as delegate of the American Section to the meeting of the Permanent International Association of Congresses of Navigation, held at Stockholm, Sweden, was offered to our dean, but duties at Ithaca prevented his acceptance.

It is needless to say that Dean Haskell's great success and unfailing devotion in the administration of our (former) College of Civil Engineering, during the fifteen years of his incumbency, is most heartily appreciated by all his present and former students. May many years of happiness and activity still lie before him!

I. P. C.

AN INVESTIGATION OF THE ONE-HINGED ARCH AND ITS COMPARISON WITH OTHER TYPES

By NEE SUN KOO, B. S., M. C. E. (1919).
McGraw Fellow in Civil Engineering, 1920-21.

An Abstract of a Thesis to be Presented to the Faculty of the Graduate School of Cornell University for the Degree of Doctor of Philosophy.

PREFACE

During the last thirty years much study has been given to the design and construction of steel arches by American engineers and investigators. Two-hinged and three-hinged arches seem to have met the greatest favor, while few no-hinged steel arches have been built in this country. One-hinged arches are practically unknown in America, although a few have been successfully constructed on the European continent. After considerable study, the author has been in doubt of the practicability and value of the one-hinged steel arch. He could see no logical or conspicuous reason against its adoption. A number of writers attack it bitterly while enumerating a few disadvantages, but fail to demonstrate or justify their statements. Others deem it unnecessary to give a full treatment, because it has not come into popular use. The deficiency of theoretical knowledge may be the reason why the building of one-hinged steel arches has been attempted so rarely. With this idea in mind, the author has undertaken a special investigation of the one-hinged steel arch.

While this work is undertaken purely for the purpose of discovering and publishing some unknown facts, some contributions made by previous investigators will be mentioned. One of the noblest and most remarkable preliminary designs which have ever been made in bridge engineering was contributed by Charles Worthington in competition with other designs for the famous Quebec Bridge. It was a one-hinged steel arch with a span of 1,800 feet, more than twice as long as that of any arch bridge then existing in the world. One of the most noted American bridge engineers, Dr. B. A. L. Waddell, in his book called "Bridge Engineering," praises the work of Mr. Worthington and calls the design ingenious and quite feasible. It is to be regretted that the scheme was not accepted by the Canadian Government and thus the complete treatment of the theoretical and practical problems involved was prevented. The work gives some indication of what could be done with the one-hinged arch and done economically. Dr. Waddell's comment is valuable on account of his extensive experience and gives promise for the future. In view of these facts, the author felt encouraged to carry on this investigation.

Special emphasis is laid upon two points, first,

to make an extensive study of its behavior in carrying the load; and second, to reveal its characteristics by critical comparisons with other types of arches. It is his hope that the work may be of value to the engineering profession in the future, if not at present. Since so little has been written in engineering literature upon the subject, it is hoped that every bit of the original work in this thesis will appeal to the sympathetic interest of engineers and investigators. Acknowledgment is due to Professor Henry S. Jacoby, chairman of the special committee in charge of the author's graduate work at Cornell University, for his aid and helpful suggestions.

Reactions Solved by the Author's Method of Symmetrical Deflection Equations.

Two kinds of beams, either straight or curved, are used in bridge building; those which are statically determinate, and those statically indeterminate. For the solution of beams of the first class, three statical equations are available:—

$$\Sigma V = 0 \dots\dots\dots(a)$$

$$\Sigma H = 0 \dots\dots\dots(b)$$

$$\Sigma M = 0 \dots\dots\dots(c)$$

For the solution of beams of the second class, three elastic conditions are available, besides the statical conditions. These are:—

$$\Delta x = \int_a^b \frac{Myds}{EI} \dots\dots\dots(d)$$

$$\Delta y = \int_a^b \frac{Mxds}{EI} \dots\dots\dots(e)$$

$$\Delta \theta = \int_a^b \frac{Mds}{EI} \dots\dots\dots(f)$$

where Δx is the horizontal deflection, Δy the vertical deflection, and $\Delta \theta$ the change of the slope between any two points on the beam, E the modulus of elasticity of its material, I the moment of inertia of a section, and M the moment at any point between a and b , where I is taken. By means of these six fundamental equations, all beams can be solved. (For the derivation of formulas (d), (e) and (f) see standard books on Mechanics). The

author has used these equations in deriving general formulas of reactions for no-, one-, two-, and three-hinged arches.

Let an arch-rib with a span l and rise h be fixed at two ends a and b , and hinged at the crown c and be subject to a vertical load P at a distance kl from the left end. (Fig. 1). The load is sustained by the reactions H_1 , V_1 and M_1 at the left support, and by H_2 , V_2 and M_2 at the right support. There are six unknowns and six conditions are required for its solution. The three statical equations furnish three conditions, while the hinge at the crown insures that the moment at that point is zero. It remains for us to find two more elastic conditions. In other words, we must choose any two equations from (d), (e) and (f) and apply them to the case of the one-hinged arch.

In order to simplify the algebraic work, the following notations are proposed by the author:—

$$p = \int_0^{\frac{1}{2}l} \frac{x ds}{I} \quad p_1 = \int_0^{kl} \frac{x ds}{I}$$

$$q = \int_0^{\frac{1}{2}l} \frac{y ds}{I} \quad q_1 = \int_0^{kl} \frac{y ds}{I}$$

$$r = \int_0^{\frac{1}{2}l} \frac{xy ds}{I} \quad r_1 = \int_0^{kl} \frac{xy ds}{I}$$

$$s = \int_0^{\frac{1}{2}l} \frac{x^2 ds}{I} \quad s_1 = \int_0^{kl} \frac{x^2 ds}{I}$$

$$t = \int_0^{\frac{1}{2}l} \frac{y^2 ds}{I} \quad t_1 = \int_0^{kl} \frac{y^2 ds}{I}$$

$$p_2 = \int_{kl}^{\frac{1}{2}l} \frac{x ds}{I}$$

$$q_2 = \int_{kl}^{\frac{1}{2}l} \frac{y ds}{I} \quad p = p_1 + p_2$$

$$r_2 = \int_{kl}^{\frac{1}{2}l} \frac{xy ds}{I} \quad q = q_1 + q_2$$

$$s_2 = \int_{kl}^{\frac{1}{2}l} \frac{x^2 ds}{I} \quad r = r_1 + r_2$$

$$t_2 = \int_{kl}^{\frac{1}{2}l} \frac{y^2 ds}{I} \quad s = s_1 + s_2$$

The hinge at the crown breaks the continuity of the beam, hence a special method must be used in applying the two elastic conditions. M. A. Howe in his book called "A Treatise on Arches" succeeds in reducing the required elastic conditions into one by means of symmetrical loading. But the method is rather lengthy, and the formulas obtained rather complicated. By means of symmetrical deflection equations, the problem is easily solved by the author, with the final formulas expressed in a very simple form. Let us assume that the arch-rib is divided into two parts at the crown by an imaginary

vertical line at the crown. (Fig. 1). Formulas (d) and (e) are used in finding the vertical and horizontal deflections between a and c and between b and c .

As the supports are actually fixed, the vertical deflection between a and i must be equal to that between b and c ; thus giving the first condition. Also, the horizontal deflections between a and c and between b and c must be equal in magnitude and opposite in direction, because what is lengthened in one-half of the rib must be shortened in the other. Thus, we obtain the second condition. For the left half of the rib with the origin at a the moment at any point between a and c is

$$M = M_1 + V_1 x - H y - P(x - kl) \dots (1)$$

For the right half of the rib with the origin at b the moment at any point between b and c is

$$M = M_2 + V_2 x - H y \dots (2)$$

Substituting (1) in (d) and (e) and replacing the integral forms with the notation above given, we have the horizontal and vertical deflections between a and c respectively,

$$E\Delta x = M_1 q + V_1 r - H t - P(r_2 - klq_2) \dots (3)$$

$$E\Delta y = M_1 p + V_1 s - H r - P(s_2 - klp_2) \dots (4)$$

Substituting (2) in the same formulas and making the same substitutions for the integral forms, we have

$$E\Delta x = M_2 q + V_2 r - H t \dots (5)$$

$$E\Delta y = M_2 p + V_2 s - H r \dots (6)$$

where the modulus of elasticity is assumed to be constant. Equating (3) to (5) and (4) to (6) as above mentioned, we have

$$M_1 p + V_1 s - H r - P(s_2 - klp_2) = M_2 p + V_2 s - H r \quad (7)$$

$$M_1 q + V_1 r - H t - P(r_2 - klq_2) = -(M_2 q + V_2 r - H t) \quad (8)$$

These two equations together with the three statical equations and the equation furnished by the hinge at the crown as shown below are sufficient to solve all the unknowns.

$$M_1 + V_1 l - Pl(l - k) - M_2 = 0 \dots (9)$$

$$M_1 + V_1 \frac{l}{2} - Hh - \frac{Pl}{2}(1 - 2k) = 0 \dots (10)$$

$$V_1 + V_2 - P = 0 \dots (11)$$

$$H_1 - H_2 = 0 \dots (12)$$

Thus, by solving (7), (8), (9), (10), (11) and (12), we have

$$H_1 = -H_2 = P \frac{klq_1 - r_1}{2(hq - t)} \quad \dots\dots (A)$$

$$V_1 = P \frac{lp - klp_1 - s - s_2}{lp - 2s} \quad \dots\dots (B)$$

$$V_2 = P \frac{klp_1 - s_2}{lp - 2s} \quad \dots\dots (C)$$

$$M_1 = -V_1 \frac{l}{2} + Hh + \frac{Pl}{2}(1 - 2k) \quad \dots\dots (D)$$

$$M_2 = M_1 + V_1 l - Pl(1 - k) \quad \dots\dots (E)$$

It must be remembered that these formulas hold good only when the load is on the left of the crown. They are applicable to a one-hinged arch with any form of arch-ribs.

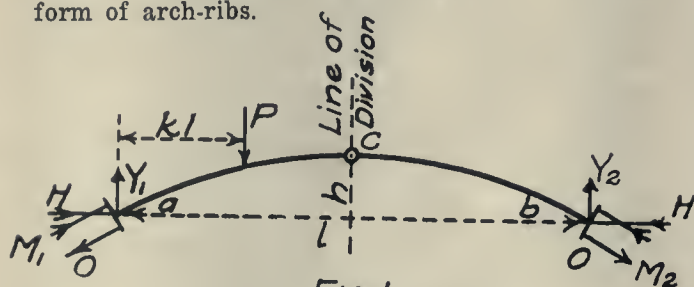


FIG. 1

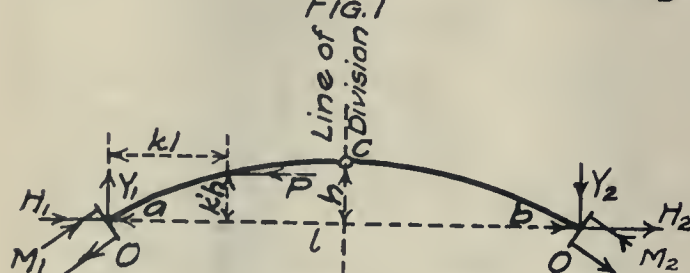


FIG. 2

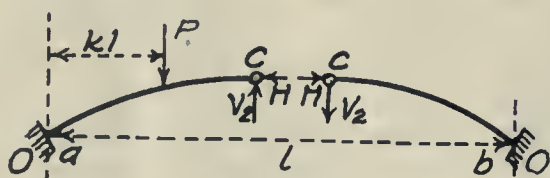


FIG. 3

E.J.S.

If instead of a vertical load P on the span, we place a horizontal load P at the same position acting towards the left and at a distance $k'h$ from the line ab , (Fig. 2) the problem can be solved in a similar way. In this case the direction of H_2 and V_2 are reversed in comparison with those under the vertical loading. The following formulas are derived for the horizontal load on the span with the same process:

$$H_1 = P \frac{2hq - h'k'q_1 - t - t}{2(hq - t)} \quad \dots\dots (F)$$

$$H_2 = P \frac{khq_1 - t_1}{2(hq - t)} \quad \dots\dots (G)$$

$$V_1 = -V_2 = P \frac{r_1 - k'hp_1}{2s - lp} \quad \dots\dots (H)$$

$$M_1 = -\frac{V_1 l}{2} + H_1 h - Ph(1 - k') \quad \dots\dots (I)$$

$$M_2 = M_1 + V_1 l - Ph'k' \quad \dots\dots (J)$$

These formulas again hold good only when the load is on the left of the crown with its direction toward the left. They are also applicable to any form of arch-ribs.

Reactions Solved by Author's Cantilever Method

Another interesting method is derived by the author in securing the two elastic equations for solving the reactions of a one-hinged arch. It is called the cantilever method, because the main feature lies in separating the arch into two separate cantilevers free at the crown and fixed at the supports. The vertical and horizontal deflections at the free end of each cantilever are then found and equated so as to furnish the two necessary equations. The method is very simple, because the deflections at the free ends of cantilevers can be easily obtained. Thus, the following deflection table includes all the data needed for the solution:

Table 1. Deflection Table for Curved Beams

| Loading | Diagram | Δx at C | Δy at C |
|---------------------------|---------|----------------------------------|----------------------------------|
| Vert. Load at kl from o | | $-\frac{P}{E}(klq_1 - r_1)$ | $-\frac{P}{E}(klp_1 - s)$ |
| Hor. Load at kl from o | | $+\frac{P}{E}(khq_1 - t)$ | $+\frac{P}{E}(k'hp_1 - r)$ |
| Vert. Load at free end | | $-\frac{P}{E}(\frac{1}{2}q - r)$ | $-\frac{P}{E}(\frac{1}{2}p - s)$ |
| Hor. Load at free end | | $+\frac{P}{E}(hq_1 - t)$ | $+\frac{P}{E}(hp_1 - r)$ |

The expressions in this table can be easily derived by using formulas (d) and (c).

In order to find the elastic conditions, let us separate the arch at the crown. Since there is no load on the right half of the rib (See Fig. 3) and since the right reaction line must pass through the crown, the two forces H and V_2 must act at the free end of the right cantilever with their directions as shown. Therefore we can consider the left cantilever as subjected to two external forces H and V_2 at the free end. On the left half of the rib there is a load P . But since action must equal the reaction, the forces acting at the free end of the left cantilever must be H and V_2 . Let us find the vertical and horizontal deflections between a and c when the loads H , V_2 , and P are acting on the left cantilever. Evidently, the vertical and horizontal deflections at c are contributed by three factors, those due to P , H and V_2 respectively. From table 1 these factors can be summed up in the expressions,

$$E\Delta y = V_2(\frac{l}{2}p - s) + H(hp - r) - P(klp_1 - s) \quad (13)$$

$$E\Delta x = V_2(\frac{l}{2}q - r) + H(hq - t) - P(klq_1 - r_1) \quad (14)$$

Similarly, the vertical and the horizontal deflections at c of the right cantilever are contributed by two factors, those due to H and V_2 . From table 1, we have the expressions,

Table 2—Reactions and End Moments of a One-Hinged Arch with Various Forms of Arch-Ribs.

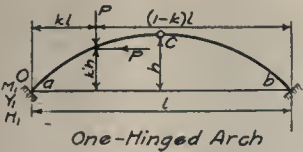
| | | | | | | | |
|---|---|-----------------------|--|--|--|---|--|
|  <p>One-Hinged Arch</p> <p>$p = \int_0^l x ds$ $p_1 = \int_0^{kl} x ds$ $p_2 = \int_{kl}^l x ds$ $q = \int_0^l y ds$ $q_1 = \int_0^{kl} y ds$ $q_2 = \int_{kl}^l y ds$ $r = \int_0^l x y ds$ $r_1 = \int_0^{kl} x y ds$ $r_2 = \int_{kl}^l x y ds$ $s = \int_0^l x^2 ds$ $s_1 = \int_0^{kl} x^2 ds$ $s_2 = \int_{kl}^l x^2 ds$ $t = \int_0^l y^2 ds$ $K = 24r^2(r - \frac{l}{2})(\frac{\pi}{2} - \alpha) + l(l^2 - 12r^2 - 6hg)$ $Q = 12r^4 - l^2 - 24r^2g(\frac{\pi}{2} - \alpha)$</p> <p>NOTE: 1. Notations as shown above. 2. Assumptions, $l = l \sec \theta$, $E = \text{constant}$, shear neglected 3. Formulae under Bending Moment hold good, when the load is on the left half of the span.</p> | <p>$t_1 = \int_0^{kl} \frac{y^2 ds}{2}$ $t_2 = \int_{kl}^l \frac{y^2 ds}{2}$ $m = \sqrt{K - K^2}$ $n = 32 - 3\pi^2$ $o = 3\pi - 8$ $\alpha = \sin^{-1}(2k - 1)$ $g = r - h$ $\cos \alpha = \frac{1}{2r}$ $r = \frac{4h^2 + l^2}{8h}$ $I = I_0 \sec \theta$ $E = \text{constant}$</p> | <p>CURVE</p> | <p>GENERAL</p> | <p>PARABOLIC</p> | <p>ELLIPTICAL</p> | <p>SEGMENTAL CIRCULAR</p> | |
| <p>BENDING MOMENTS</p> | <p>VERTICAL LOAD</p> | <p>H</p> | <p>$P \frac{klq_1 - r_1}{2(hq - t)}$</p> | <p>$\frac{5}{2} \frac{Pl}{h} (2k^2 - k^4)$</p> | <p>$\frac{Pl}{2ho} \left\{ 4(4k^2 - 4k + 3)m + 3(1 - 2k)(3\pi - 2\alpha) \right\}$</p> | <p>$\frac{P}{2h} \left\{ 8r^2 \sin^2 \alpha + 3r^2 (1 - 2k) \sin 2\alpha + 2\alpha - 2\alpha^2 - \frac{1}{2} l^2 (1 - 2k + 4k^2) \right\}$</p> | |
| | | <p>V₁</p> | <p>$P \frac{lp - klp_1 - s - s_2}{lp - 2s}$</p> | <p>$P(1 - 4k^3)$</p> | <p>$P(1 - 4k^3)$</p> | <p>$P(1 - 4k^3)$</p> | |
| | | <p>V₂</p> | <p>$P \frac{klp_1 - s_1}{lp - 2s}$</p> | <p>$4Pk^3$</p> | <p>$4Pk^3$</p> | <p>$4Pk^3$</p> | |
| | | <p>M₁</p> | <p>$-V_1 \frac{l}{2} + Hh + \frac{Pl}{2}(1 - 2k)$</p> | <p>$-\frac{Pl}{2}(2k - 14k^3 + 5k^4)$</p> | <p>$-\frac{V_1 l}{2} + Hh + \frac{Pl}{2}(1 - 2k)$</p> | <p>$-\frac{V_1 l}{2} + Hh + \frac{Pl}{2}(1 - 2k)$</p> | |
| | | <p>M₂</p> | <p>$M_1 + V_1 l - Pl(1 - k)$</p> | <p>$\frac{Pl}{2}(6k^2 - 5k^4)$</p> | <p>$M_1 + V_1 l - Pl(1 - k)$</p> | <p>$M_1 + V_1 l - Pl(1 - k)$</p> | |
| | <p>HORIZONTAL LOAD</p> | <p>H₁</p> | <p>$P \frac{2hq - k'hq_1 - t - t_2}{2(hq - t)}$</p> | <p>$P(1 - 20k^3 + 40k^2 - 16k^4)$</p> | <p>$\frac{P}{o} \left\{ \frac{o + 4k(3 - 3k + 2k^2)}{-3m(2\alpha - 3\pi)} \right\}$</p> | <p>$P - H_2$</p> | |
| | | <p>H₂</p> | <p>$P \frac{k'hq_1 - t_1}{2(hq - t)}$</p> | <p>$4P(5k^3 - 10k^2 + 4k^4)$</p> | <p>$P - H_1$</p> | <p>$\frac{6lg^2 - 2kl(12r^2(13 - 6\pi + 4\pi^2)) - 3r^2(\sin 2\alpha + 2(4\pi - \alpha)) + 6lg(1 - 4k)\sin \alpha}{2K + 6lg(1 - 4k)\sin \alpha}$</p> | |
| | | <p>V₁</p> | <p>$P \frac{r_1 - k'h p_1}{2s - lp}$</p> | <p>$\frac{8Ph}{l}(2k^3 - 3k^2)$</p> | <p>$\frac{Ph}{2l} \left\{ \frac{4m(4k^2 + 2k + 3)}{6\alpha + 9\pi} \right\}$</p> | <p>$P \left\{ \sin^2 \alpha + \frac{3}{2} \sin 2\alpha + 6K^2 \sin \alpha - \frac{3}{2} \alpha \right\}$</p> | |
| | | <p>V₂</p> | <p>$-P \frac{r_1 - k'h p_1}{2s - lp}$</p> | <p>$-\frac{8Ph}{l}(2k^3 - 3k^2)$</p> | <p>$-V_1$</p> | <p>$-V_1$</p> | |
| | | <p>M₁</p> | <p>$-\frac{V_1 l}{2} + H_1 h - Ph(1 - k)$</p> | <p>$4Ph(k^2 - 7k^3 + 13k^2 - 4k^4)$</p> | <p>$-\frac{V_1 l}{2} + H_1 h - Ph(1 - k)$</p> | <p>$-\frac{V_1 l}{2} + H_1 h - Ph(1 - k)$</p> | |
| | | <p>M₂</p> | <p>$M_1 + V_1 l - Pk'h$</p> | <p>$-4Ph(3k^3 - 7k^4 + 4k^5)$</p> | <p>$M_1 + V_1 l - Pk'h$</p> | <p>$M_1 + V_1 l - Pk'h$</p> | |
| | <p>TEMPERATURE EFFECTS</p> | <p>RIB SHORTENING</p> | <p>H₁</p> | <p>$\pm \frac{E \epsilon t^2 l}{2(hq - t) + \frac{l}{r_1^2}}$</p> | <p>$\pm \frac{15 E \epsilon t^2 l_0}{2h^2 + 15r_1^2}$</p> | <p>$\pm \frac{12 E \epsilon t^2 l_0}{oh^2 + 12r_1^2}$</p> | <p>$\pm \frac{12 E \epsilon t^2 l_0}{K + 12lr_1^2}$</p> |
| | | | <p>M₁</p> | <p>$\mp \frac{E \epsilon t^2 l h}{2(hq - t) + \frac{l}{r_1^2}}$</p> | <p>$\mp \frac{15 E \epsilon t^2 l_0 h}{2h^2 + 15r_1^2}$</p> | <p>$\mp \frac{12 E \epsilon t^2 l_0 h}{oh^2 + 12r_1^2}$</p> | <p>$\mp \frac{12 E \epsilon t^2 l_0 h}{K + 12lr_1^2}$</p> |
| | | | <p>H₁</p> | <p>$-\frac{sl}{2(hq - t)}$</p> | <p>$-\frac{15sl_0}{2h^2}$</p> | <p>$-\frac{12sl_0}{oh^2}$</p> | <p>$-\frac{12sl_0}{K}$</p> |
| | | | <p>M₁</p> | <p>$+\frac{shl}{2(hq - t)}$</p> | <p>$+\frac{15sl_0}{2h^2}$</p> | <p>$+\frac{12sl_0}{oh^2}$</p> | <p>$+\frac{12sl_0}{K}$</p> |

Table 3—General Formulas of Reactions and End Moments of an Arch with the Regular Form of Arch Rib.

$$p = \int_0^l x ds$$
$$p_1 = \int_0^{kl} x ds$$
$$p_2 = \int_{kl}^l x ds$$
$$q = \int_0^l y ds$$
$$q_1 = \int_0^{kl} y ds$$
$$q_2 = \int_{kl}^l y ds$$
$$r = \int_0^l x y ds$$
$$r_1 = \int_0^{kl} x y ds$$
$$r_2 = \int_{kl}^l x y ds$$
$$s = \int_0^l x^2 ds$$
$$s_1 = \int_0^{kl} x^2 ds$$
$$s_2 = \int_{kl}^l x^2 ds$$
$$t = \int_0^l y^2 ds$$
$$t_1 = \int_0^{kl} y^2 ds$$
$$t_2 = \int_{kl}^l y^2 ds$$
$$I = I_0 \sec \theta$$
$$E = \text{Constant}$$

NOTE:

1. Formulae for one and three Hinged Arches under the term Bending Moment hold good, when the load is on the left of C.

2. Rise or Fall of Temperature has certain effect upon l of the three Hinged. The formula is not derived, as its effect upon the truss can best be found by the graphical method. (—)

3. Notations are shown above.
 r_1 = radius of Gyration. s = unit compressive stress in Rib-shortening Formulae. (average stress)

| ARCH | | | NO-HINGED | ONE-HINGED | TWO-HINGED | THREE-HINGED |
|-----------------|---------------------|----------------|---|--|---|-----------------------|
| BENDING MOMENTS | VERTICAL LOAD | H | $\frac{Pl}{2} \frac{(r_1 + k l q_1) - l q (k - k^2)}{l^2 - 2q_1^2}$ | $P \frac{klq_1 - r_1}{2(hq - t)}$ | $P \frac{r_1 + k l q_1}{2t}$ | $\frac{Pl}{2h}$ |
| | | V ₁ | $\frac{M_2 - M_1}{l} + P(1 - k)$ | $P \frac{lp - klp_1 - s - s_2}{lp - 2s}$ | $P(1 - k)$ | $P(1 - k)$ |
| | | V ₂ | $P - V_1$ | $P \frac{klp_1 - s_1}{lp - 2s}$ | Pk | Pk |
| | | M ₁ | $\frac{2H_1 l_0}{l_2} (4lq - 3r_1) - Pkl(1 - k)$ | $-V_1 \frac{l}{2} + Hh + \frac{Pl}{2}(1 - 2k)$ | 0 | 0 |
| | | M ₂ | $M_1 + V_1 l - Pl(1 - k)$ | $M_1 + V_1 l - Pl(1 - k)$ | 0 | 0 |
| | HORIZONTAL LOAD | H ₁ | $\frac{Pl}{2} \left\{ \frac{l(r_1 + k'hq_1) - q_1 l q_2}{1 + \frac{k'h l (1 - 2k)}{l^2 - 2q_1^2}} \right\}$ | $P \frac{2hq - k'hq_1 - t - t_2}{2(hq - t)}$ | $\frac{P}{2} \left(1 + \frac{t_2 - k'hq_2}{t} \right)$ | $\frac{P}{2}(2 - k')$ |
| | | H ₂ | $P - H_1$ | $P \frac{k'hq_1 - t_1}{2(hq - t)}$ | $P - H_1$ | $\frac{Pk'}{2}$ |
| | | V ₁ | $\frac{1}{l}(M_2 - M_1 + Pk'h)$ | $P \frac{r_1 - k'h p_1}{2s - lp}$ | $\frac{Pk'h}{l}$ | $\frac{Pk'h}{l}$ |
| | | V ₂ | $-V_1$ | $-P \frac{r_1 - k'h p_1}{2s - lp}$ | $-\frac{Pk'h}{l}$ | $-\frac{Pk'h}{l}$ |
| | | M ₁ | $\frac{2H_1 l_0}{l_2} (4lq - 3r_1) + \frac{2Pl}{l_2} [s(r_1 - r) - 2l(q - q_1)] + Pk'h(1 - 4k + 3k^2)$ | $-\frac{V_1 l}{2} + H_1 h - Ph(1 - k)$ | 0 | 0 |
| | | M ₂ | $M_1 + V_1 l - Pk'h$ | $M_1 + V_1 l - Pk'h$ | 0 | 0 |
| | TEMPERATURE EFFECTS | H ₁ | $\pm \frac{E \epsilon t^2 l}{2t - \frac{4q_1^2}{l} + \frac{l}{r_1^2}}$ | $\pm \frac{E \epsilon t^2 l}{2(hq - t) + \frac{l}{r_1^2}}$ | $\pm \frac{E \epsilon t^2 l}{2t + \frac{l}{r_1^2}}$ | — |
| | | M ₁ | $\mp \frac{2 E \epsilon t^2 q}{2t - \frac{4q_1^2}{l} + \frac{l}{r_1^2}}$ | $\mp \frac{E \epsilon t^2 l h}{2(hq - t) + \frac{l}{r_1^2}}$ | 0 | 0 |
| RIB SHORTENING | RIB SHORTENING | H ₁ | $-\frac{sl}{2t - \frac{4q_1^2}{l}}$ | $-\frac{sl}{2(hq - t)}$ | $-\frac{sl}{2t}$ | 0 |
| | | M ₁ | $+\frac{shl}{t - \frac{2q_1^2}{l}}$ | $+\frac{shl}{2(hq - t)}$ | 0 | 0 |

$$E\Delta y = -V_2\left(\frac{l}{2}p-s\right) + H(hp-r) \quad \dots(15)$$

$$E\Delta x = -V_2\left(\frac{l}{2}q-r\right) + H(hq-t) \quad \dots(16)$$

The value of E is assumed to be constant in all of these expressions. Equating the vertical deflections from each half of the rib, we have

$$\begin{aligned} V_2\left(\frac{l}{2}q-r\right) + H(hq-t) - P(klq-r_1) \\ = -V_2\left(\frac{l}{2}p-s\right) + H(hp-r) \quad \dots(17) \end{aligned}$$

from which the formula for V_2 can be obtained directly. Equating the horizontal deflections we have

$$\begin{aligned} V_2\left(\frac{l}{2}p-s\right) + H(hp-r) - P(klp-s_1) \\ = V_2\left(\frac{l}{2}q-r\right) - H(hq-t) \quad \dots(18) \end{aligned}$$

from which the formula for H can be obtained directly. From the statical conditions and the condition furnished by the hinge at the crown, we can obtain all necessary formulas for the reactions and the bending moments at the ends.

In the case of the horizontal loading, the above method applies equally well. The expressions for the vertical and horizontal deflections at the free end of a cantilever under a horizontal load P are also given in table 1.

Influence of Temperature

Changes in temperature cause changes in the values of M_1 and H_1 but do not affect the vertical reaction V_1 . It is usually specified that an arch shall be designed to be subject to a certain variation in temperature from a standard value. Let Σ be the coefficient of expansion and t° the rise of temperature, then the span length will be increased by $\Sigma t^\circ l$ provided one end is free to move. As both ends are fixed in position when the supports do not yield, equal and opposite reactions and end moments are produced. The values of H_1 and M_1 must be such as to prevent the horizontal displacement $\Sigma t^\circ l$, which is due to the effect of bending and thrust. The horizontal deflection due to bending and thrust are given by the following expressions:

$$\Delta x_1 = \int_0^l \frac{My ds}{EI} \quad \dots(19)$$

$$\Delta x_2 = \frac{H_1 l}{AE} \quad \dots(20)$$

in which A is the area of cross-section. Equating the deflections, and

substituting $H_1(h-y)$ for M and solving for H_1 and M_1 , we have

$$H_1 = \frac{\pm Eet^\circ l}{2(hq-t) + \frac{lr_1^2}{I_0}} \quad \dots(K)$$

$$M_1 = \mp \frac{Eet^\circ hl}{2(hq-t) + \frac{lr_1^2}{I_0}} \quad \dots(L)$$

where I_0 is the moment of inertia of the section at the crown and r_1 is the radius of gyration of the same section. For a rise in temperature use the positive sign for H_1 and a negative sign for M_1 . For a fall in temperature, the reverse is true.

Rib-Shortening

The direct effect of the thrust along the axis is to shorten the axis of the arch-rib. It would also shorten the span provided one end were free to move, but as this is not the case it will develop equal and opposite negative reactions H_1 and positive moments M_1 . The effect of displacement due to H_1 and M_1 must equal that due to rib-shortening. Let us use S as the average compressive stress on the rib. The shortening of the span is given by

$$\Delta = \frac{Sl}{E} \quad \dots(21)$$

which must be equal to

$$\Delta = \int_0^l \frac{My ds}{EI} \quad \dots(22)$$

Equating (18) to (19), substituting $H_1(h-y)$ for M in the equation, and solving for H_1 , we have

$$H_1 = - \frac{Sl}{2(hq-t)} \quad \dots(M)$$

$$M_1 = \frac{Shl}{2(hq-t)} \quad \dots(N)$$

Application to Parabolic, Segmental Circular, and Elliptical One-Hinged Arches

The general formulas derived above have been applied to three forms of arch-ribs with parabolic, segmental circular and elliptical curves respectively. The equations of these curves all have their origin at the left support a , with the X-axis passing through the supports a and b . The equations of these curves are as follows:

$$y = 4h\left(\frac{x}{l} - \frac{x^2}{l^2}\right) \quad \dots(23)$$

$$(y+r-h)^2 = 2r\left(x+r-\frac{l}{2}\right) - \left(x+r-\frac{l}{2}\right)^2 \quad \dots(24)$$

$$\frac{\left(x-\frac{l}{2}\right)^2}{\left(\frac{l}{2}\right)^2} + \frac{y^2}{h^2} = 1 \quad \dots(25)$$

An important assumption is made in applying the general formulas, that is $I=I_0 \sec \alpha$ where I is the moment of inertia of the cross-section at any point and

(Continued on page X)

THE STANDARDIZATION OF SALARIES AND GRADES IN PUBLIC EMPLOYMENT

By JOHN TOWNSEND CHILD, C. E. '12

Answering the Question as to How Public Offices Can be Made as Efficient as Private Offices.

By Standardization of Salaries and Grades is meant the establishment of a definite and more or less automatic employment policy to cover the entrance selection and subsequent public career of persons in the civil service along definite lines of work, exclusive of course of elective officers and appointive heads of departments.

Standardization is a step beyond civil service and has an important bearing on the question of public employment. It strikes at the root of the spoils system in politics which still exists in spite of civil service legislation and established laws. Civil Service, as it is operated, is admittedly a failure and really accomplishes just one purpose and that is the prevention of the wholesale handing out of jobs when political turnovers occur. It is now capable of all sorts of manipulation through the establishment of non-competitive positions and its operations admit of appointments of persons not as well qualified as others who did not show up as well in written examination. Many cases occur where persons fresh from school or college can outstrip in examination, others with intimate knowledge of the practical side of the job. However, the great faults in municipal employment are the lack of opportunity for a career, the poor pay and the almost utter lack of reward for competence and faithful service. These are accentuated by rewarding the good and the bad alike. When residence regulations are forgotten and when city employees can graduate from the small town job to the larger city job, as they do in England, we will have better qualified public officials because civil service will then offer a real career and will attract the best grade of citizens. Civil service as it exists also has another great fault which has been characterized as "the lack of a back door." When once established under civil service a job is too apt to be a sure thing—the good, bad and indifferent employees, the lame, the halt and blind stay on forever to the detriment of the service. When an employee leaves the service an unexperienced one comes in at the same pay. Where pensions are provided, there is some relief, but unless pensions are compulsory at a given age many hang on ten or 15 years after their usefulness has become seriously reduced. No one wants to depreciate the value of long and faithful public service, but the aged should be cared for in ways which do not render inefficient the public service and thus accentuate the difficulty of maintaining a satisfactory organization. In all large organiza-

tions there are a few places where elderly men can be used to advantage, but in a good size city injustice is done either to the individual in city employ or the position. In cities, well organized politically, it is apt to be the job that suffers and in large private corporations the individual.

Standardization has for its prime purpose the establishment and administration of a business like organization with provision for advancement and promotion in the various functional branches. In a city of 300,000 or more the functions are numerous and varied. The employees represent 90 to 100 more or less distinct vocations, trades or professions, some of which are represented in one or two departments and some in all of them. Furthermore, standardization is designed to provide substantially equal pay for similar duties in all departments and to provide concise titles appropriate to the position and descriptive of the work involved as far as is possible. For example, an official title now in actual use is "skilled mechanic in charge of grit chambers." This is descriptive to the nth degree, but under a standardized system it would be merely "supervising mechanic" with general qualifications and duties given in the classification.

In investigations of the conditions of employment in city services, under civil service, but not standardized, it has been found that there are many rates of pay for similar or related work. For example, it was found in Rochester, N. Y., that there 101 clerks worked under 35 distinctive titles and at 27 salary rates ranging from \$490 to \$3,000 a year; 214 inspectors had 24 different titles and rates from \$827 to \$2600; 33 engineers (mostly civil) had 24 titles and 558 skilled laborers (so called) worked under one title at 36 different rates of pay; 171 other skilled laborers had 55 distinctive titles with salaries from \$682 to \$3,000. With these few examples in mind, it is easy to see the desirability for some systematic arrangement for establishing positions and salaries.

With a standardized classification of positions made up, the present incumbents must be fitted into the classification by a process of appraisal. Fair and just appraisals can be made only upon the thorough knowledge of the employee's service record. This is one of the first essentials of standardization and complete records of all employees must be obtained before any adequate classification of positions can be made up. Service records must be made out by the employee himself, including title,

name, age, department and division record of civil service appointments and manner of each, salaries and promotions, employment before entering the service and a brief outline of the kind and extent of present duties. Such records should also include time devoted to duties, vacation allowed, uniformity of volume of work, number of subordinates and remunerations and benefits other than salary. The records should be revised and checked by the employee's immediate superior and department heads. Many employees are found to be working out of title, that is, at duties other than those indicated by the titles. In the appraisal these would be given titles pertaining to the duties actually performed. In case salaries received are higher than those assigned to the standardized positions, they should remain the same. In the change to a new classification no salaries should be reduced because the individual is not responsible for the conditions prevailing and the chief benefits are supposed to affect those entering the service and in future salary adjustments. On the other hand, an employee should be moved up to at least the entrance salary assigned to his new title in case he was not getting the pay commensurate with his duties.

With the service records of each employee complete, the new classification is made up by a logical grouping of positions into services which offer definite lines of continued service with promotion. Police and Fire Departments of large cities are always the best organized in this regard. Many kinds of work cannot offer as well defined lines of service, but such services as engineering, clerical, street cleaning, book-keeping, building and other inspection, chemical, and the commoner skilled trades are each readily formed into from three to seven distinct grades within a group. Each grade of service may have one or more titles with appropriate duties for similar grades of work. This may occur in many general kinds of work such as for instance:—Health Inspector Group. Grade II. Titles of positions—Milk Inspector, Food Inspector, Diphtheria Inspector. It is readily seen that the details of the work are different but the grade of service required is about the same and the pay would therefore be about the same. Also from one of these kinds of inspectors it might become necessary to choose a chief inspector (Grade III Health Inspector Group) to have supervision over all of them which is another and important reason for grouping them together. In engineering services each grade would probably require three titles such as say for Grade I, Engineering Assistant, Junior Draftsman and Junior Engineering Inspector. Here again the duties are different, but the grade of work is about the same.

The specifications of positions must include not only titles and duties, but definite, general qualifications subject to civil service rules and regulations.

These are very important both at the entering and higher grades. The qualifications should be mental, physical or educational (in school or practice). In the higher grades usually all of these are necessary. In a labor group, physical qualifications are of course to be given first consideration. In skilled labor, experience or apprenticeship is necessary. The entrance grade for a clerk would require a high school or business school education and no experience; but entrance or promotion to Grade II would require a year or more experience in work of the character and standard of Grade I in addition to the qualifications for Grade I and so on up to Chief Clerk, Grade V.

The salary question can only be settled after the complete classification is set up. Then with the more or less definite grades of service established it becomes necessary to determine the prevailing rates of similar grades of work in industry and business within the city in question. Comparison with rates in other cities is not of much value because living costs vary considerably in different localities. Even in one city the comparison is not an easy one because the same titles usually represent different duties and qualifications and hence are not directly comparable. To get accurate salary figures the actual positions in question must be reduced to the terms of the standardized classification. Thus a "Chief Clerk" in some office may correspond to a "Senior Clerk" in the new classification. In engineering work an "Assistant Engineer" may mean most anything from a Junior Draftsman to a Division Engineer. To arrive at satisfactory and fair rates, it is therefore necessary to obtain local figures from as many sources as possible for each grade of work and from these an average range of rates can be arrived at for any given grade in any Group. It is desirable to have a range of from \$200 to \$500 for each grade so that there may be advancement without change of duties to provide for faithful and competent service. Entrance to a grade should be at the lowest rate and advancement made upon recommendation of the appointing officer after specified periods of service. This gives opportunity for rewarding deserving employees but may be subject to abuse by unfair executives.

The importance of a satisfactory and practical standard employment policy is better realized when it is understood that well over 50% of the modern city's budget goes to pay for the one general object of personal service. From this is also seen the need for a yawning "back door" for the enforced exit of the lazy and incompetent. Standardization as proposed is criticised for not being specific enough in this regard. The "back door" provision of civil service is there but it doesn't open easily enough. The appointing officer should not be given arbitrary

(Continued on page VII)

SOME THINGS WE DO NOT KNOW ABOUT ROAD CONSTRUCTION

By JOHN STANLEY CRANDALL

Consulting Engineer, The Barrett Company.

Showing That in Road Construction, at Least, the Old Proverb to the Effect That "When Ignorance is Bliss 'tis Folly to be Wise" is Disproved.

If you should motor through this country picking up, as you go along, the men responsible for the building of the roads over which you are at the moment passing, and if you listened attentively to what they were telling you, you would finally come to the conclusion that the road problem is one with many factors, not any of which are constants. The comments would run something like this:

"Last winter was extremely cold, and mighty little snow in this part of the country. Frost went down 5 feet below the surface of this road, and when the spring thaws came along they didn't do a thing to it." And from the way the road looks and rides you heartily agree.

"Well, we thought we had this road pretty well drained, but by George, about twice a year these soft places bust out here and there, and it looks like there are springs that flow once in a while and are dry at other times."

"No, Sir, you just naturally can't drain this soil. The water comes right up to the top of the road every time, no matter what kind of drains we use. We've tried most everything. Nothing works. The water even comes right up through a perfectly good concrete base and disintegrates the wearing course. I don't know what to do."

"We built this road in the fall. The weather was cold, and the bitumen never did penetrate—just laid on top where it had chilled—and now it's been bleeding like this all summer long, and I don't know how much longer it's going to keep it up."

"We built this road in the early spring, and it rained and rained every day, it seemed. Anyway, the road is no good, and never will be."

"We couldn't get the right kind of cover for this road. So we had to take what we could get. We expected a failure, but look at it! It's better than that other road which was built exactly according to specifications."

"This stone was left so soft that it broke up under the roller, and so the road never was in first class shape."

"The roller was so light that the road metal wasn't thoroughly compressed."

And so on, indefinitely. You could listen to these road builders day after day and month after month, hearing a different tale from each one as to why such and such a road had failed. After hearing 500 or more stories, you would be in a position to classify

the causes for failures, and perhaps the classification would take some such form as this:

Unfavorable soil conditions.

Unfavorable weather conditions.

Poor or inadequate drainage.

Poor quality of materials of construction.

Faulty workmanship.

Misuse of materials.

Contractor skimping the job.

Graft.

Careless inspection.

Ignorance and stupidity.

Wrong type of road crust.

Poor design.

No maintenance, no repairs.

Too heavy loads for foundation.

We know a good deal about some of these, and of some others we know almost nothing. The most surprising thing is that we know the least about that factor which we have had with us since the beginning of time, namely, soils. We know today almost as little as Adam did—and maybe less—about the behavior of soils when used as foundations for roads. But we are going to learn something some time, and we have made a beginning, although a late one. No engineer today can do more than guess at the bearing power of any soil. Hence there is considerable chance for failures to occur, since in some cases one man's guess is as good as another's, and both may be wrong. The Office of Public Roads is working on this problem now, and some interesting data have been collected. This work is but the beginning. What has been done to date has been described recently in some of the technical journals.

In every state in the Union there are gravel deposits, and a well made and carefully maintained gravel road is excellent for light traffic. But there are few men who know anything about gravel. The New Englander knows the gravels in his part of the world, the Texan knows his, and the Wisconsinite knows his, perhaps, but none of these knows anything about the other's gravels, and what passes for gravel in one part of the country may be classed as sand in another. There seems to be no standard as to what constitutes a gravel. This has led to much confusion, and also to many failures in recent years. Some gravels may be successfully treated with bituminous materials, while others similarly treated fail to hold up. Each gravel seems

to be a law unto itself, and so far as we know today, the only way to determine whether or not a gravel will take a treatment successfully is to try out a sample section of road. Untreated gravel roads rapidly go to pieces under motor car traffic, while those gravels that will successfully take a tar surface treatment stand up under rather heavy traffic, provided there is a patrol maintenance system in use. There are many things to be learned about gravel, and to date very few people have made a study of this important road building material. It should receive national as well as local attention.

And, when we come right down to it, there isn't so very much authoritative information at hand about stone for road work. In modern highway construction stone is the important factor, since it amounts to over 90% of the material entering into the road. I have seen stone used that was so soft that it broke when a wheel-barrow passed over it, and I have seen some so brittle that, though hard, it cracked to pieces when the roller went over it once. Such material is worthless for road making, yet it has been and will be used until our road builders know more about the materials they are working with. Many times, other materials that have been used, as asphalt, tar, cement, have been condemned for causing failures when really the poor quality of stone used was the cause. In the sheet asphalt industry much research work was done on sand, with the result that now it is rather definitely known exactly how sand should be graded, and what kinds may be used to secure good sheet work. Sooner or later such research work must be carried out for all materials of highway construction.

But the best of materials will not be satisfactory if the workmanship in their use is not good. The tremendous increase in the highway construction programs of states, counties and municipalities has resulted in a scarcity of skilled road builders. There are not enough experienced men to go round, and, while there are many young men being trained, they are not yet ready to take their places as responsible road men. Consequently, many miles of road have been built and have failed all too soon because no one on the job knew how to use the materials at hand. It frequently happens that the companies that furnish the materials of construction are called on to instruct road builders in the use of their materials. Indeed, most of the large companies furnish engineering service with their goods and are glad to see to it that complete information is supplied to the consumer. New problems that come up from time to time are considered from every angle by engineers and chemists of wide experience. The purchaser of the material receives for nothing information that may have cost a large sum to derive. There is no excuse today for the engineer untrained in highway matters not being

able to find out the best way to solve his own particular problem.

When I went to college I had it drummed into me that all contractors were little better than thieves. Later I learned better, and I found that there are many reputable contractors who want to live up to not only the letter of their contracts but also to the spirit. Still, the fact remains that there are a few unprincipled contractors who will "skin the job" every chance they get, and these men make it hard for the honest contractor to allay suspicion. The dishonest contractor and graft go hand in hand, of course, but happily conditions are improving, and the contractors themselves are foremost in cleaning house.

Often contractors are accused of fraud, when, in reality, there never was a thought of deception. Instead, they are all too often ignorant and stupid, and these traits make them do things that seem to be fraudulent.

But the item that we know least about is how to educate the taxpayer, the engineer, the politician and everybody in the country to the fact that ALL types of pavements and roads MUST have constant maintenance. How to get that idea across, so that it will stick and produce results in the form of funds for maintenance work, is a question. And it is a serious question. Probably the answer is: Preach the doctrine of maintenance everywhere, all the time, and never stop until patrol maintenance is assured on every main road of the land.

Perhaps the foregoing is a rather gloomy picture of the present status of roadbuilding. Perhaps you will conclude that as there is so much we do not know about road construction that there is little left that we do know. The many miles of good roads through the country prove that we know some things, at least, and give promise of our learning much more. New conditions have suddenly confronted us, and during the past twenty years we have had to revise those ideas that had been satisfactory for millions of years before. If we learn as much about highway engineering in the next decade as we have in the last we may look forward to an era of good roads everywhere.

FACULTY NOTES

The Faculty of the new College of Engineering held its first meeting on February 21, 1921. President A. W. Smith presided. Organization plans were discussed, and a committee was appointed to take up the details of organization. Professor C. L. Walker, C. E. '04, who has been Secretary of the Civil Engineering Faculty, was elected to that position for the combined Faculty.

THE CORNELL CIVIL ENGINEER

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COLLEGE NOTES

The Honor System Movement

Sometime prior to the February examinations a move was instigated by the students for the adoption of an honor system here at Cornell. The movement secured considerable publicity at that time owing to the fact that a dozen or more students visited every fraternity and club house on the Hill and delivered short speeches explaining what such a proposed system would mean, how it would work, and what its advantages would be. In a short time the idea developed considerable momentum—in fact the College of Architecture which formerly had no codified honor system actually applied an honor code, patterned along the general lines of the C. E. system, to all its mid-year examinations. The time was too short, however, for a general University system to either be drawn up or even seriously considered by the whole student body. For this reason the committee which had developed the proposal decided to wait until the second term and then lay the plan before the students as a whole, thereby securing their opinion about the adoption of such an honor system.

In accordance with this plan booths were opened on February eleventh and twelfth so located that students could express their approval or disapproval of the plan as they were registering for the second term. The results of this referendum, or census of student opinion, was so favorable that the student committee, which represented all the colleges, met and drew up a rough draft of a proposed constitution which was sent to the deans of all the colleges and to various faculty members for their criticism. As a result of the suggestions received, the original draft was revised, and the constitution was put in its final form, in which it was to be presented to the student body for their approval or disapproval.

The constitution in its final form was published in the Sun, and on Friday and Saturday, March fourth and fifth, the students voted on its adoption. In this referendum over thirty-five hundred votes were cast in favor of the system while only three hundred and fifty-four negative votes were recorded. In spite of the fact that over a thousand students did not express their opinion the total number of votes cast was the largest that has ever been cast in any undergraduate expression of opinion. Following this favorable result the student committee drew up a resolution, in which they requested that the faculty ratify the constitution of the proposed honor system. At the faculty meeting held Wednesday, March ninth, the system was unanimously approved after a very short discussion relating mainly to the ways and means of the system.

The constitution of the honor system, as it now stands, states that the system shall rest solely on the honor of each student, that each college shall have its own honor system committee whose members shall be elected by the students of that college, and that these committees shall conduct hearings of all cases of student breaches of honor in their own colleges and report their findings with recommendations to the Cornell Honor Committee. This latter committee shall be composed of five members of the Student Council, the president of the Women's Self-Government Organization and the chairmen of the various college committees. This committee shall have complete judicial power in all cases relating to student honor. The constitution also makes a provision that unless it is approved by more than three-quarters of the students it cannot be adopted.

If one needs evidence that honor systems are successfully operated he has but to look at any one of a number of our larger institutions of learning. Princeton for example has been under such a system

for twenty-six years. In a statement made by Dean McClenahan, who is in charge of University discipline, he declared that the cases of proven cribbing during this quarter of a century could be counted on the fingers of both hands. Furthermore he stated that in his undergraduate days at Princeton, when there was no honor system in vogue, cribbing was one of the favorite pastimes. If an honor system has accomplished such an improvement at Princeton is it not likely that as much can be accomplished at Cornell?

In the outside world an employer hires a man on the strength of what he claims he knows or can do. Business is individualistic in the extreme—cribbing in business is impossible—one must either know or be ignorant—he cannot get the answer from his neighbor. From common sense reasoning, then, why should a man want to get credit for something he does not know when he is sure to be held liable for that knowledge later on in business? In the ultimate, work in college is but a preparation for business. Let's be fair and square with our best friends, ourselves.

Varsity Basketball

The basketball season is now a thing of the past. Taking it all in all the Varsity has had a successful season. The game with Dartmouth February 15 was a fast and exciting one, Dartmouth winning by four points. Their defense was the stiffest the Varsity has encountered this year. The Varsity lost to Penn at Philadelphia on February 19 by 22-20. The game was exceedingly fast and the Varsity lead at the end of the first half. This was the first time this year that a team had lead Penn at the end of the first half.

The Varsity won a slow game from Marrietta on February 22 by the score of 27-23. Many substitutions were made and the game dragged out to the final whistle. In a close game on February 25 the Varsity defeated Columbia at New York 20-17. This game left two more league games to be played. Rutgers sprung a surprise on the Varsity at New Brunswick on February 26 by staging a comeback in the final period of a fast game and winning 32-26 after Cornell was ahead at the end of the first half 16-10.

On March 5 the Varsity played a return game with Syracuse at Syracuse which they won by a score of 23 to 19. The first game with Syracuse held here on January 11 resulted in a 25 to 13 victory for the Varsity. On March 9 Cornell played Columbia at Ithaca and defeated them by a score of 31 to 18. Three days later the Varsity met the Yale quintet in the New Armory and won by a score of 43 to 9. As a result of these games Cornell finished the season in third place in the league, Penn again taking the championship.

The Spring baseball practice started with **Baseball** the new term and is now well under way.

Coach Carney, former Phillips-Exeter coach, issued his call the middle of February and about a hundred men signed up. These men were placed in squads according to the position they played. The squads were called out for practice on different days, and cuts have been made until Mr. Carney now has the men from whom he expects to be able to pick a team which will be able to play first class college baseball.

The baseball season opens with a six-game southern trip. Among the new teams met this year are Fordham, Ohio Wesleyan, Washington and Lee, University of Detroit and possibly Lehigh.

April 7—Virginia at Charlottesville.

April 8—Virginia at Charlottesville.

April 9—Georgetown at Washington.

April 11 — University of Maryland at College Park, Md.

April 12—Catholic University at Washington.

April 13—Penn at Philadelphia.

April 23—Colgate at Ithaca.

April 27—Rochester at Ithaca.

April 30—Harvard at Cambridge.

May 4—Columbia at Ithaca.

May 7—University of Detroit at Ithaca.

May 13—Lafayette at Easton.

May 14—Fordham at New York City.

May 19—Colgate at Hamilton.

May 21—Yale at Ithaca (Spring Day).

May 25—Ohio Wesleyan at Ithaca.

May 28—Yale at New Haven.

June 1—Columbia at New York City.

June 16—Washington and Lee at Ithaca.

June 17—Alumni or open.

June 18—Penn or Alumni.

The Triangular Track Meet at Boston

On Saturday, February 26 the Varsity track team added another scalp to its large collection when it won the annual triangular track meet with Dartmouth and Harvard at Boston. The meet was one of the most exciting held in Mechanics Hall in some time.

The team after a slow start in the field events came rapidly to the front in the races, taking every place in the 1000 yard race and the first two places in the 600 yard run as well as second and third places in the mile run. This totaled 21 points which with the points gained by winning the fast mile relay served as a good foundation for the various places gained in the dashes and field events. One peculiar feature of the meet was the five cornered tie for third place in the pole vault. Dartmouth having three fingers in the pie and Cornell and Harvard each having one.

The running of Captain McDermott, a senior in

(Continued on page VII)

ALUMNI NOTES

'89 We are notified that the address of Elmore D. Cummings is now 4608 15th St., N. W., Washington, D. C.

'90 N. Seymour Crouch may be addressed either in care of the Shepherd Engineering Company, Williamsport, Pa., or at 127 W. 11th St., Erie, Pa.

'91 Carl E. Davis has been appointed a Hydraulic Engineer for the Memphis Artesian Water Department.

'92 William G. Atwood has notified us that his address has been changed from 42 Broadway, New York, to 2117 Railway Exchange Building, St. Louis, Missouri. Mr. Atwood is now the Manager for the St. Louis District of the Woods Brothers Construction Company.

'94 Arthur H. Place is Engineer in the Bureau of Government Research at Detroit, Mich.

'99 Clifford H. Belden has changed his mailing address to 34 Bristol Street, New London, Conn. Mr. Belden is the General Manager of E. S. Belden & Sons, Inc., of Hartford, Conn.

'01 W. C. Affeld is President of the Twin City Trading Company, 106 Chamber of Commerce Building, Minneapolis, Minn. He lives at 2725 Colfax Ave., So., Minneapolis, Minn.

'01 Alexander F. Armstrong is a practicing Civil Engineer with offices at 19 South Hawk Street, Albany, N. Y.

'01 Irving C. Brower has been discharged from the army and is now City Manager of Pontiac, Mich. He gives his home address as 34 Liberty Street, Pontiac.

'01 John P. Churchill is Chief Engineer of the Hay Foundry & Iron Works, Newark, N. J. He lives at 19 Whittlesey Ave., E. Orange, N. J.

'05 Albert S. Brainard is Engineer Salesman for the Standard Oil Company (N. J.) at 31 Clinton Street, E. Orange, N. J. His new address is 87 N. 18th St., E. Orange.

'07 Herbert S. Austin, who is superintendent of the Oklahoma Pipe Line Company, writes us that he is now living at 320 North 12th St., Muskogee, Okla.

'07 Robert M. Davis, Statistical Editor of the Electrical World, has been elected a member of the American Statistical Association. He notifies that his address has been changed to 36 Queens Road, Queens, N. Y.

'08 Mr. Everett Drennen, President of the West Virginia Coal and Coke Company, is chairman of the fair practices committee of Northern West Virginia coal operators. He has recently been to New York to discuss with Charles S. Allen, secretary of the Wholesale Trade Association, plans for the elim-

ination of the speculation in coal. Dr. Drennen says that the present situation was caused by labor and transportation troubles, but believes that the worst feature of the distribution problem, "illegitimate brokerage," can be controlled through the cooperation of the operators. He declared the operators had suffered from unfair methods employed by a small minority, brokers who came into the field to make great profits in a short time when prices began to rise because of transportation congestion. The activities of the committee have proved effective in the lowering of prices, and the chairman is confident that if it is permitted to function on a large scale, the committee will be able to relieve conditions more generally.

'09 Robert W. Clark is president of the Clark Construction Company of Waterbury, Conn. His home address is 11 Woodlawn Terrace, Waterbury.

'09 Albert Diamant has been elected an Associate Member of the American Society of Civil Engineers. His address is Tocopilla, Chile.

'09 Dalton Moomaw is Road Engineer for St. Joseph County, Ind., and has charge of surveys, plans and construction of county improvements. At present he has 27 miles of pavement under contract.

'09 Don O. Stone writes us that he has changed his address from 2410 Indiana Ave. to 1095 Elmwood Ave., Columbus, Ohio. Mr. Stone is secretary and treasurer of The Crowell and Stone Company, Bituminous Contractors of Columbus, Ohio.

'10 Edward V. Baron has announced that he is now in the contracting business in Detroit, Mich., with offices at 809 Empire Bldg.

'10 Warren E. Day is Resident Engineer of the Phoenix Utility Company at Nesquehoning, Pa.

'10 Amos O. Nisenson, who is a member of the firm of Lake and Nisenson, Consulting Engineers, of Newark, has recently been elected a member of the American Society of Civil Engineers.

'11 Harry W. Butts is manager of the Hedden Place Machine Co., of East Orange, N. J. His new address is 52 Williams St., E. Orange.

'11 Joseph J. Chamberlain, Jr., is Chief Engineer of the Danis Hunt Construction Company of Dayton, O. His address is 1723 Grand Ave., Dayton, O.

'11 Ralph S. Crossman is Professor of Civil Engineering at Des Moines University, Des Moines, Ia.

'11 Harvey S. Johnson has been transferred from Junior to Associate Member of the American Society of Civil Engineers. He is Assistant Engineer with the Bossert Corporation, 1408 Oneida Street, Utica, N. Y.

'11 Gustav Schirmer has been elected an Associate Member of the American Society of Civil Engineers.

'12 Chester A. Adee is a patent attorney with the Western Electric Company, Inc. He received his J. D. degree from N. Y. U. in 1920, and was admitted to the N. Y. Bar Dec. 20, 1920. Mr. Adee married Miss Mary Coulson, sister of R. E. Coulson, A. B. '09, on Dec. 20, 1918. They have a son, Thomas Coulson Adee, born Jan. 12, 1920, and live at 252 13th Ave., Astoria, L. I.

'12 Robert W. Austin is with the General Motors Export Co., 120 W. 42d St., New York City. His home address is 612 Myrtle Ave., Albany, N. Y.

'12 John T. Child is a Sanitary Engineer at 25 Main Street, Rochester, N. Y. He lives at 194 Oxford St., Rochester. He informs us that James E. Cuff, '12, is now a lawyer with Sutherland & Dwyer, Rochester, N. Y.

'12 Albert B. Clunan writes us that his address is now 693 Flatbush Ave., Brooklyn, N. Y.

'13 Arthur W. Beale is a contractor at 240 Rutgers Street, Rochester, N. Y. We are advised that his address is now 66 Shepard St., Rochester, N. Y.

'13 P. DeWitt Brown, a draftsman and designer at the Fort Pitt Bridge Works of Pittsburgh, has changed his residential address to 235 Chestnut Street, Sewickley, Pa.

'13 Rodney D. Brown is a Highway Engineer with the U. S. Bureau of Public Roads. He lives at 3215 17th St., N. E., Washington, D. C.

'13 A. B. Cozzens is Secretary of the Minor Trading Corporation at 149 Broadway, New York City.

'13 E. Russell Davis is Chief Civil Engineer of the City of Newport News, Va. His home is at 310 55th St., Newport News.

'13 A. A. Lacazetto has recently written us saying that he has been with the West India Oil Co., of New York, since his graduation and has charge of the construction of a large number of Oil stations in Cuba and Porto Rico. In 1915 Lacazetto received the degree of M. E. from Columbia University.

'13 Theodore L. Welles, Jr. has been transferred from Junior to Associate Member of The American Society of Civil Engineers.

'14 George A. Chase, Jr., Superintendent of the Claim Department of the Home Friendly Society, Industrial Insurance, has changed his address to 2003 Longwood St., Baltimore, Md.

'14 Willis H. Hanchett is now Assistant Engineer on maintenance work for the Nashville, Chattanooga, and St. Louis Railway at Chattanooga, Tenn.

'14 Charles Kirschner is Assistant Field Engineer for the Board of Commissioners of the Port of New Orleans on the construction of a lock for the Inner Harbor Navigation Canal.

'14 Edward C. Panton has been elected an Associate Member of the American Society of Civil Engineers.

'15 Charles R. Adelson is Assistant Factory manager for the United States Retail Candy Stores, 130 E. 13th Street, New York. He lives at 2446 Creston Avenue, New York City.

'15 E. S. Baker is Secretary of the A. B. Smythe Company of Cleveland. His address is 9610 Clifton Blvd., Cleveland, O.

'15 Alvin G. Cadiz is a practicing Civil Engineer at 473 14th Street, Brooklyn, N. Y.

'15 Matthew L. Carey has been elected a member of the American Economists Association and also of the National Association of Cost Accountants. Mr. Carey is Statistician for the U. S. Rubber Company, 1790 Broadway, New York City.

'15 Frank P. Cartwright is a staff member of the Rochester Bureau of Municipal Research, 25 Main Street, East, Rochester, N. Y. He belongs to the Rochester Engineering Society. John T. Child, '12, and James W. Routh, '14, are at the same place.

'16 Abram F. Bacharach is a salesman with the Detroit Trailer Company, Grand Central Palace, N. Y. C. His home address is 1331 W. North Ave., Baltimore, Md.

'17 W. Addams, Jr., is in the Grain, Seed and Feed Business in Cynthiana, Kentucky, with offices at 109 South Main Street.

'17 Herman Berman writes us that his address is now 1218 Shepherd St., N. W., Washington, D. C. Mr. Berman is Assistant Examiner in the U. S. Patent Office.

'17 Charles H. Bunn, Jr., is in the general engineering department of the Standard Oil Company (N. J.), Elizabeth, N. J. He belongs to the American Petroleum Institute. His address is 143 So Munn Ave., E. Orange, N. J.

'17 Charles D. Livant notifies us that his address is now 1413 Grant Ave., Bethlehem, Pa.

IN MEMORIAM

Mrs. E. J. McCaustland

News has reached Ithaca of the death of the wife of Elmer J. McCaustland, M. C. E. '97, a member of the faculty of this college until 1907 and now Dean of Engineering at the University of Missouri. Mrs. McCaustland had been ill for some time and had submitted to surgical and radium treatment without relief. About the eighth of February septacemic fever developed, and she passed away on the eighteenth.

That she remained brave and cheerful until the end in the face of impending death will be well understood by all those fortunate enough to have known her. Besides Dean McCaustland she leaves two children Gwynne and Margaret.

STANDARDIZATION OF SALARIES AND GRADES IN
PUBLIC EMPLOYMENT

(Continued from page 115)

powers in this regard but upon reasonable grounds and after hearing from the employee in question, the executive should have power to free his department of dead wood. The way this now works under civil service is that aldermanic pressure is brought to bear and the employee if one of the faithful is "taken care of" in some way or other and the executive made to backdown. The result is utter lack of discipline.

The benefits to be derived from standardization as outlined are (1) A fixed policy for a businesslike employment procedure. (2) A scientific basis for budget making in matters pertaining to personal service. (3) More attractive careers in public service with definite lines of promotion and advancement. (4) The prevention of fictitious and unnecessary positions. (5) Simplified civil service records and procedure. (6) A more wholesome regard for public employees and employment. (7) A definite basis for future adjustments of salary rates.

Probably the only way that these things can be brought to realization and continued application is through public demand. If public sentiment cannot obtain them between elections—the next ballot should register their dissatisfaction. Public employees are behind this movement almost to a man and the wise politician may also find in it refuge from many of the unpleasant petty situations which continually confront the man in office.

COLLEGE NOTES

(Continued from page 119)

C. E., was one of the features on the meet. It was due to his final spurt in the 1000 yard run, which landed him in third place after he had passed several of his opponents, that Cornell won the meet. He had already taken second in the mile run after he was passed in the last hundred yard spurt by Captain O'Connell of Harvard.

In the freshman relay race, the Cornell runners had little difficulty in placing first. They were unable, however to place a man in the finals of the 40 yard dash.

In as much as this was the first appearance of "Jack's" team in an indoor meet this season, it speaks well for their success in the future meets, chief among which is the indoor meet with Michigan at Ann Arbor later on this term. The track schedule also includes the Penn Relays, a dual meet with Penn, and the intercollegiates at Cambridge.

March 26—Michigan indoor meet at Ann Arbor.

April 29 and 30—Penn Relays at Philadelphia.

May 14—Dual meet with Penn at Ithaca.

May 27 and 28—Intercollegiates at Cambridge.

DAYLIGHT ILLUMINATION.

The angle of refraction being equal to the angle of incident, it is a simple matter to determine the correct angles to use in manufacturing glass which will give good illumination. But for proper industrial plant illumination, there is more to be considered than mere deflection of light. The direct beam of light must be eliminated in order to prevent sun glare, which is objectionable on account of its causing heavy shadows and strong contrasts which decrease the efficiency of employees and necessitate the use of shades which in turn reduce the light to such an extent that daylight illumination any distance from the light source is not sufficient. Therefore, in order to produce a glass which when used in the windows of industrial plants will produce as near to ideal illumination as possible, we must first eliminate the direct rays of the sun by deflecting the light to the ceiling and side walls which re-deflect it back to a distance 25 to 50 feet from the window throughout the entire working area. To accomplish this we have scientifically designed a type of glass which is named "Factrolite."

Factrolite consists of 30 ribs to the inch, running at right angles, forming 900 pyramidal prisms or 3,600 light deflecting surfaces which completely disintegrate the direct beam of light from the sun. Furthermore, the depressions in the surface of Factrolite are so slight that the accumulation of dirt and dust is minimized and can be perfectly cleaned with an ordinary dry scrubbing brush. Incidentally, the cleaning of windows is most important for keeping up production and increasing the efficiency of any industrial plant and should be given more consideration in plant management.

If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

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The New Chemistry Building

The ground for the new chemistry building which is to occupy the portion of the campus east of Lincoln Hall and north of Rockefeller Hall is almost cleared of the debris which accumulated from the razing of the residences formerly occupied by ex-president Schurman, Prof. E. A. White and Prof. C. L. Durham.

Many an Alumnus who enjoyed the hospitality of these homes at one time during his undergraduate career will learn of their disappearance with a mixed feeling of regret and satisfaction,—regret to think of their going and satisfaction to realize that the building which is to replace them will fill a long-felt need.

It has taken several weeks to complete the task of razing the dwellings, and it is not definitely known at the present time when construction on the big chemical laboratory will be started. Comptroller C. D. Bostwick, '94, although he could not mention any specific date for the commencement of actual building operations stated that he hoped for a beginning early this summer. Specifications are now being completed by Gibb and Waltz of Ithaca, and as soon as they are finished, the University treasurer will call for bids and the work will be started.

The new laboratory, on which \$5,000,000 will be

expended, will be erected and equipped to take its place as the leading college laboratory of its kind in the country, according to plans outlined by Prof. L. M. Dennis, Head of the Department of Chemistry and other members of the Chemistry faculty.

Cornellians may justly boast of the new and modern chemical laboratory which is soon to grace the Campus, and Lincoln Hall may well be proud of its new neighbor located just across the street.

Lacrosse Practice Started

On February 23 an informal smoker was held at which 45 men registered for the 1921 Lacrosse squad. Coach Bawlf told of how last year out of inexperienced men a team was formed that lost but two out of ten games. These games included some with experienced teams and one of the strongest teams met during the season was that representing Syracuse. This year there are but two members of last year's team left but Mr. Bawlf expects to be able to form a team fully as strong as if not stronger than last year's team. Due to the open weather, practice is being held daily on Alumni field, and by the time of the spring trip, which is about five weeks off, Cornell should have a team which is able to compete with any other team in the east.

THE CORNELL CIVIL ENGINEER

and

Transactions of the Association of Civil Engineers of Cornell University

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Vol. XXIX

APRIL, 1921

No. 7

EDITORIALS

Finances Again In our February issue we published a statement of our finances and at that time we sent out bills to those 320 men who owed (and most of whom still owe) us money on subscriptions. From those bills we received the sum of \$232 out of the \$1,325 the bills called for—a total of approximately 17%. Our thanks are extended to those who paid that 17%, but we are unable to understand why the other 83% will not come to life. We realize that engineering work is slack at present and that a lot of you are running pretty low, but—so are we. We realize that you have other bills to pay, bills which must be paid, for which you will be dunned otherwise, and if something must be overlooked, our bill seems the easiest to let go, and then you think, "I'll pay that subscription next month." But when next month comes around the same thing happens all over again in the same vicious circle, and the CORNELL CIVIL ENGINEER still has a debit entered on your ledger card.

Then there are others of you, we realize, who have not sent us your check merely because you have forgotten us. Those of you who are in this condition of mental lethargy we ask to wake up or, in slang parlance, "come to and come across".

Then there are a few of you who have lost or mislaid our statements or who believe that there is a mistake in them and are waiting to hear from us again before taking any step toward paying us. To those of you who are in this class we say "Write to us and tell us about it." We will gladly send you another statement, or, if you believe we have made a mistake, discuss the matter with you.

The country over is suffering from a period of financial depression, and, as with a great many of the other technical journals, the CIVIL ENGINEER is feeling the results of this depression through the curtailment of its advertising. Therefore we must depend to a greater extent than is usually necessary upon our subscription income, and it is for that reason that we must ask you to send us your checks as soon as possible.

As we have said before, the greater majority of our bills are contracted with the usual discount of

2% for cash within ten days, and if we were able to take advantage of this discount we could affect considerable saving. As it is now, with so many outstanding debts we are obliged to let these savings slip through our fingers.

If we could, we would write letters to every one of you individually and tell you just how things stand, and we feel certain that we would shortly collect all our outstanding accounts. Unfortunately however we have a certain amount of work to do in the way of studies, reports, prelims, etc., so that it is impossible for us to keep in touch with each of you personally. Therefore we will have to ask YOU to consider this request for remittance as addressed specifically to YOU and to take the course of action that this request asks you to take NOW, please.

We sincerely hope that we will not have to arraign any or all of you again. Frankly, we don't enjoy having to do it any more than you probably enjoy reading it, so let's pull together for a bigger and a better CORNELL CIVIL ENGINEER, and as its your move first, let's hear from you all soon with a check enclosed with your best wishes for the future. Thanks in advance.

The Business Manager

The A. S. C. E. On the twenty-fifth of April the application of the Cornell Society of Civil Engineers for a Student Charter will come before the meeting of the Board of Direction of the American Society of Civil Engineers, and at the time of our going to press there is every indication that the application will be acted on favorably. The formation of the student chapter is looked on very favorably by all except those few cynics and confirmed stand-patters who are always present in any organization of any kind. The professors are on the whole among the foremost to praise this latest plan of the Association.

It can not be refuted that having a Cornell Chapter of the A. S. C. E. for the students of the college will be a good advertisement for the college. Other leading engineering schools throughout the country have established student chapters and have received welcome publicity and welcome aid therefrom in the way of securing speakers for various purposes.

As a report by the secretary has to be presented to the secretary of the society once a year by the local secretary the chances are that meetings will be held oftener and made better, so that a better local organization will result for this reason alone; for it is human nature to try to do things better when one knows that the results of his endeavors will be laid open to his superiors, and therefore the President of the Association will be influenced in about the proverbial ninety-nine cases to bring about a better association.

Then of course, as mentioned above, there is the direct aid that the A. S. C. E. furnishes to student chapters in the way of aiding them to secure better speakers more frequently, an advantage which can not be stressed too much. Often more can be learned by listening to the words of a successful engineer and learning how he overcame the powers of nature than by reading some musty tome on the theoretical side of the very same subject, for, in the ultimate, it is the human equation that so often determines the success or failure of an engineering feat.

It must be remembered, however, that the Charter will not, as some of its enthusiastic supporters would have us believe, give us a magical cure-all for lack of college spirit, nor will it induce painlessly better and more successful meetings. These will only be obtained through a careful selection of efficient officers, backed by the hearty cooperation of every student in the college.

As the athletic office would have it, **College Spirit** "when students wore whiskers and board was three dollars a week" or in other words "in the good old days" and even in the somewhat later days just before the war, the College Spirit of a Civil Engineering Student was known, respected, and admired all over the Hill. Evidences of that spirit are still with us in the form of trophies decorating the library. But since the good old days of 1914, C. E. trophies appear to have gone out of style and C. E. championships to have been banished from their rightful places. Since these days C. E. College Spirit seems to have followed what is the most frequently occurring curve in Nature, the sine curve. It appears to have at last reached its lowest point and should, now, according to the law of the curve, begin to rise once more. The question is, however, will it?

The question is one which you and I must answer for ourselves because we are the ones, and the only ones, who can make it rise. The only way in which the C. E. College can regain its former prestige on the athletic field is by its members getting out and doing something. The job cannot be left for someone else to do. The trouble is that when the athletic director of the college asks for candidates to sign up to take part in this or that, the first thought is "Whats the use?" and the second thought is "Let George do it." The upperclassman figures that "mere" intercollege athletics are not worth his time and energy, and that he had far better spend his

time on that Concrete Report or that Water Supply or that Bridges Report or whatever other report with which he is at that time afflicted. On the other hand the underclassman figures, "Whats the use of my going out for anything like that. All those older upperclassmen will go out, and all I would ever do would be to make a fool out of myself. I might just as well read that last story in the Saturday Evening Post." And so it goes. It is once again the same old story of "pass the buck."

Everybody, whether they are Seniors or Frosh should, and, if they were only not so lacking in college spirit, would, show up when the call for candidates comes, whether it be for the college crew or the college indoor track team. Most men do not realize that the old Roman Motto of "mens sano in mens corpore," "a sound mind in a sound body," was drafted for the Roman students and is one that holds for the students of today just as much as it did for the students two thousands years ago. The best way, so the doctors tell us, to gain and to keep a sound body is by exercise. The best way to exercise is through a sport and not by a set of exercises, for good competitive sport will exercise the brain as well as the body and give a better all-round development to the brain and to the body than will a set of exercises consisting, say, of pulling the weights for a certain length of time. Moreover, and particularly is this true in the case of crew and will be according to Coach Carney in baseball, future candidates for the Varsity squads are drawn from the candidates for positions on the teams in the Intercollege League. Often men, who, because of their greenness went out for the college team, had no expectation other than gaining exercise, have in the following year made the Varsity squad and then the team.

Spring is upon us once more and shortly the call for men for the college teams for the various spring sports will be issued. Whether you know anything about the sport or not, come out for the team. You will be guaranteed a lot of fun, a good time, plenty of exercise, a chance to meet your college mates on common grounds, and a chance too, if your inclinations run that way and the team as a whole is good enough, to win a medal emblematic of the championship, besides, of course, the usual shingle which is presented by the C. E. Association to the members of all C. E. Teams.

Heres hoping the sine curve is going to take a sharp upward curve and, defying all laws of Nature, Mathematics and Mechanics, become the comparatively rarer Tangent Curve and continue on ever upward until it reaches infinity. Then may the library be graced with some new decorations, and the watch fobs of the men in the college with some of those medals of the intercollege association. Lets Go!

STRENGTH OF CEMENT-SAND-LIME MORTARS

PROF. H. H. SCOFIELD, '05

The Results of Tests Started by Prof. Scofield While He Was at Purdue University—The Results of These Tests Should Be of Interest to Every User of Cement-Sand-Lime Mortars.

In a paper by Warren E. Emley published in the Proceedings of the American Society for Testing Materials, 1917, results of a series of tests were given "to show some of the more important properties of a cement-sand-lime mortar." The fine aggregate used in all the tests was standard Ottawa sand.

In a discussion of the paper at that time, the writer objected to the use of standard Ottawa sand mortar to give information concerning the properties of commercial mortars containing hydrated lime.

Mr. Emley's results showed an increased strength in Ottawa sand mortars with small percentages of lime admixtures in as rich a mortar as 1 to 1 by weight. This did not seem possible to the writer if natural sands or screenings were used in which

strength on these specimens at an age of three and one-half years, have just been made.

The gradation of sizes of sand and screenings is shown by the sieve analysis curves in Fig. 1. The fine aggregates all graded from fine to 1-4 inch in size with a varying amount of fines.

The degree of wetness in mixing was medium and judged by the eye in each case, being constant for all mixes. No attention was paid to "workability" or "water-ratio" at the time of mixing the mortars. The "solidity-ratio" or density of each mortar was obtained by actual measurement of volume of mortar produced. The mortars were molded into 2 inch cubes. These were cured in moist air for 24 hours, in water for approximately 1 year after which air storage prevailed until time of test.

TABLE 1.
Tests of Cement-Sand-Lime Mortars

| 1 to 1½ by weight. | | | 1 to 3 by weight. | | | | 1 to 6 by weight. | | | |
|--------------------|-----------------|---------------------------------|-------------------|----------|-------|---------|-------------------|-------|---------|----------|
| Lime Admixture | | Coarse Sands (Uniformly Graded) | | | | | | | | |
| Vol. | Per Cent by Wt. | W/C | Density | Strength | W/C | Density | Strength | W/C | Density | Strength |
| 0 | 0 | .432 | .743 | 10090 | .607 | .820 | 8900 | .975 | .819 | 4080* |
| 23.5 | 10 | .504 | .723 | 8360 | .627 | .809 | 7900 | 1.069 | .822 | 4290* |
| 47.0 | 20 | .609 | .687 | 7760 | .742 | .788 | 7387 | 1.142 | .827 | 4496 |
| 69.5 | 30 | .708 | .669 | 7290 | .870 | .768 | 6823 | 1.222 | .832 | 5080 |
| Medium Sands | | | | | | | | | | |
| 0 | 0 | .537 | .705 | 9944 | .748 | .722 | 8212 | 1.210 | .755 | 3903* |
| 23.5 | 10 | .603 | .691 | 8260 | .814 | .759 | 7106 | 1.250 | .773 | 4025 |
| 47.0 | 20 | .678 | .672 | 7800 | .889 | .747 | 6500 | 1.327 | .773 | 4100 |
| 69.5 | 30 | .754 | .651 | 7300 | 1.012 | .726 | 5586 | 1.405 | .769 | 3940 |
| Fine Sands | | | | | | | | | | |
| 0 | 0 | .562 | .689 | 10121 | .806 | .734 | 6400 | 1.391 | .729 | 2848 |
| 23.5 | 10 | .637 | .679 | 8550 | .870 | .728 | 6200 | 1.455 | .732 | 2785 |
| 47.0 | 20 | .712 | .653 | 8068 | .941 | .718 | 5837 | 1.534 | .737 | 2836 |
| 69.5 | 30 | .792 | .641 | 7500 | 1.064 | .702 | 5300 | 1.611 | .724 | 2718 |

*Visible Voids.

Notes: The cement was a mixture in equal parts of Atlas, Alpha, Cosmos, and Universal. Weight of the cement is assumed 94 pounds per cubic foot. Specific Gravity 3.15. The lime was a commercial brand. Assumed weight was 40 pounds per cubic foot. Specific Gravity 2.5. The sand was a washed bank sand artificially graded. Specific Gravity 2.65. W/C — water ratio, the ratio of volume of water to volume of cement.

Amount of lime is expressed as percentage of cement.

there is a greater or less variation in size of particles and in which frequently there is present a sufficiency if not an excess of fine particles approaching the size of hydrated lime particles. It would seem that the addition of hydrated lime should therefore decrease the density and strength especially in the richer mixtures and finer aggregates.

A series of tests were started by the writer, at that time, in the Materials Laboratory, Purdue University, to check these results and give additional information when commercial sands and screenings were used for fine aggregate. The final tests for

Results of the Tests

The tabulated results of the tests are given in Tables 1 and 2. Each result is the average of from 3 to 9 determinations, made usually in separate batches and on different days.

The water-ratio W/C is the ratio of volume of mixing water used to the volume of cement in each mix. This assumes 94 pounds per cu. ft. as weight of cement. This is not corrected for the amount of water absorbed by the aggregate or by the hydrated lime.

The solidity-ratio or density was computed as the ratio of the total absolute volume of all the solids in a batch to the volume of the batch, measurement being made while the mortar was green.

The results are shown graphically in Figs. 2 and 3.

Discussion

The following conclusions may be drawn from the results as shown:

- 1. For the material tested and in the proportions used the strength is lowered by the addition of hydrated lime except that in the lean mix and coarser aggregates the strength is increased.
- 2. The density of the mortars tested measured when green is decreased by the addition of hydrated lime except that in the lean mix and coarser aggregates the density is increased.

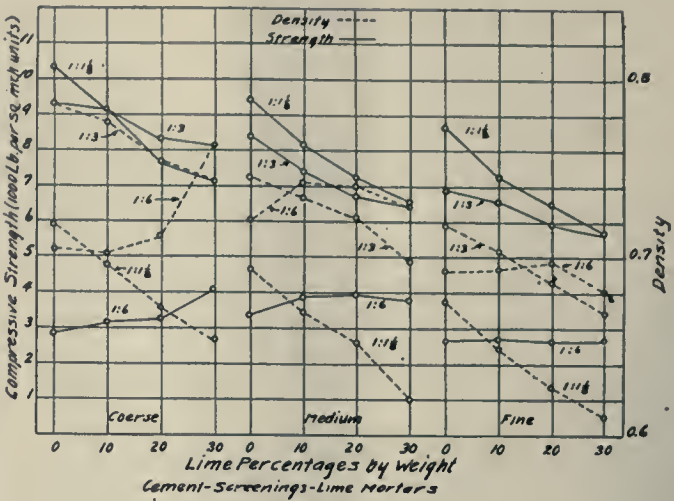


FIGURE 3

TABLE 2.
Tests of Cement-Screenings-Lime Mortars

| 1 to 1½ by weight. | | | | | 1 to 3 by weight. | | | 1 to 6 by weight. | | |
|---------------------|------------|--------------------------------------|---------|----------|-------------------|---------|----------|-------------------|---------|----------|
| Lime Admixture | | Coarse Screenings (Uniformly Graded) | | | | | | | | |
| Per Cent by Vol. | W/C Wt. | | Density | Strength | W/C | Density | Strength | W/C | Density | Strength |
| 0 | 0 | .520 | .718 | 10333 | .644 | .785 | 9316 | 1.180 | .704 | 2877* |
| 23.5 | 10 | .595 | .695 | 9171 | .740 | .776 | 9133 | 1.249 | .702 | 3157* |
| 47.0 | 20 | .670 | .671 | 7563 | .812 | .753 | 8300 | 1.326 | .711 | 3291* |
| 69.5 | 30 | .754 | .654 | 7171 | .933 | .743 | 8108 | 1.403 | .763 | 4088 |
| Medium Screenings | | | | | | | | | | |
| 0 | 0 | .565 | .693 | 9410 | .805 | .745 | 8369 | 1.350 | .720 | 3383* |
| 23.5 | 10 | .641 | .669 | 8153 | .888 | .733 | 7400 | 1.430 | .742 | 3884* |
| 47.0 | 20 | .716 | .652 | 7271 | .966 | .722 | 6700 | 1.548 | .740 | 3970 |
| 69.5 | 30 | .803 | .620 | 6500 | 1.078 | .697 | 6450 | 1.625 | .727 | 3790 |
| Fine Screenings | | | | | | | | | | |
| 0 | 0 | .602 | .675 | 8666 | .869 | .718 | 6889 | 1.715 | .691 | 2628 |
| 23.5 | 10 | .678 | .649 | 7270 | .966 | .703 | 6521 | 1.755 | .693 | 2683 |
| 47.0 | 20 | .754 | .627 | 6500 | 1.063 | .686 | 5967 | 1.845 | .697 | 2624 |
| 69.5 | 30 | .840 | .610 | 5700 | 1.185 | .668 | 5607 | 1.925 | .681 | 2684 |

*Visible Voids.

Notes: The screenings were a gray Indiana limestone artificially graded. Specific Gravity 2.78.

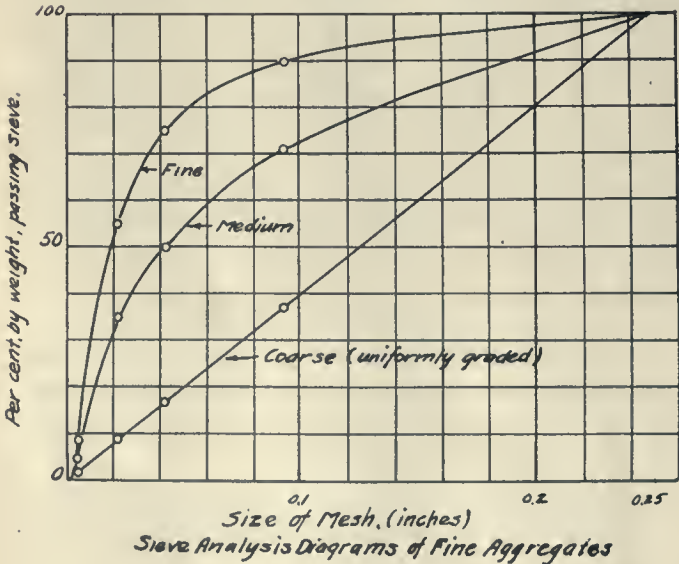


FIGURE 1

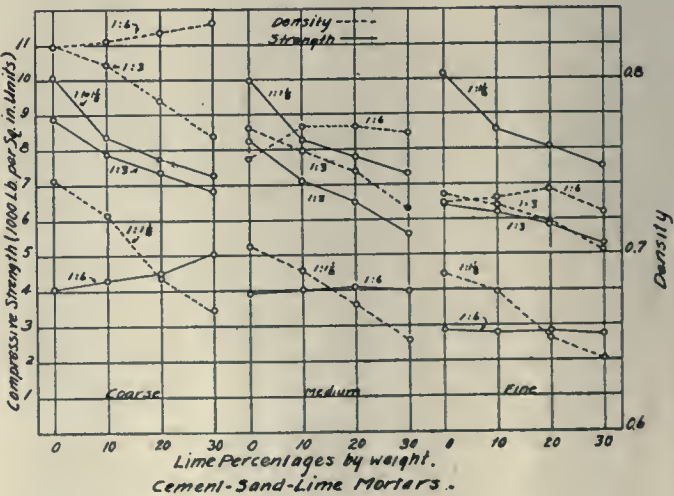


FIGURE 2

- 3. The water necessary to produce a given degree of wetness without regard for workability of

the mass, is increased by the addition of hydrated lime.

(Continued on page V111)

PRETEST FOUNDATIONS

By G. H. S. McNAIR, C. E., '18

Scientific Pile Driving Is a Subject Unknown to the Layman, and of Mystery to Many an Engineer—Mr. McNair Here Draws Aside a Portion of the Veil and Reveals a Few Facts About Pretest Foundations.

The invention about five years ago of the Pretest method of driving piles, and the popular acceptance of this pile for foundation work under certain conditions, naturally led to the design of a type of foundation particularly adapted to use this pile with greatest efficiency. And as this development makes radical departure from the usual practices, and demands a considerable enlargement of our fundamental conceptions of what a building foundation ought to be, it may be of interest to describe the Pretest Foundation, and show, in their simplest form, the principles involved in the design.

It is not to be supposed that this principle of construction can be applied to every type of building in every type of locality; but for the foundations of office buildings, warehouses, and other massive types, upon soil which is too soft for spread footings, and where bedrock or hardpan is too deep to be easily reached, the Pretest Foundation provides the logical solution to the problem.

The type of pile used, and the methods of driving it, were developed in the quicksand areas of lower New York. It is well-known that the downtown end of Manhattan Island is built upon sand, indeed there is in general no bedrock or hardpan to be found at less depth than 60 to 100 feet below the street, while the water-table is 25 feet or less below the surface. As a result of the activities of subway building in this region, extending over many years, a great deal was added to our knowledge of the behaviour of piles in soft ground, and some reliable types developed as a result.

A discussion of the theory of the most modern practice in this connection was published in the Cornell Civil Engineer of April 1920, but for those to whom that article is not available, a brief description of the Pretest pile, and its functions, should be here inserted, in order that we may understand the action of each unit, before considering them combined to form the completed structure.

The actual make-up of the pile is not peculiar. Most commonly used is a hollow cylindrical steel shell, about 19 inches in diameter, shipped in sectional lengths 2 feet long. This is filled with concrete, and driven into the ground by hydraulic rams, reacting against an existing structure of sufficient weight, additional sections being added to the pile as necessary. As the pile penetrates, it gives an increasing reaction to the hydraulic ram, and eventually "fetches-up" at the pre-determined load. The virtue of the Pretest system of driving piles consists in the patented method by which, at this point

in the process of driving, the reaction of the pile is transferred to the superincumbent building, without allowing the pressure upon the top of the pile to be for one moment relieved. This prevents an upward rebound of the pile, due to the elasticity of the compressed soil at its base. It has been found by observation that, once a pile has been allowed to rebound, it will not "fetch-up" again under a load without considerable penetration into the ground. This action has heretofore been the cause of settlement of structures placed upon piles in soft ground. The Pretest system of transferring the load to the pile, by insuring that the "rebound" does not occur, eliminates the settlement. This discovery that it was possible to transfer a building load to a pile in soft ground, without settlement of the pile and the structure placed upon it, suggested the method of foundation design now under discussion. The first step is to cast a reinforced concrete girder on the ground at about the level of the sub-basement of the building to be erected. Above this girder will be built the superstructure, and below it the foundation. Both are installed almost simultaneously, the foundation, however, being allowed a few weeks start on the superstructure. After the girder has been cast, and has set, the first few piles are located by excavating underneath a portion of it, and are driven down by hydraulic rams reacting against the weight of the girder above. This means, of course, that the girders must be sufficiently massive for the purpose, and they usually vary between 1 and 2 tons per foot of length. Perhaps one pile in every group of four is thus driven for preliminary support, and when sufficient bearing power to carry a couple of stories has been secured, steel erection may be begun, the grillages being grouted into the concrete girder, and the brickwork laid with the girder as a footing. As the work goes on, the foundation man must provide as much support by driving piles beneath the girder, as is called for by the weight of the superstructure above the girder. The state of advancement of the foundation work must be such that the bearing capacity of the piles balances the building load at any given time, until, shortly before the completion of the building, all the piles are driven and tested according to the specifications of the architect. Throughout these operations, very careful levels are kept on the reinforced concrete girder to see that it is not settling, but that it is remaining absolutely stationary.

Figures 1 and 2 illustrate in plan and elevation

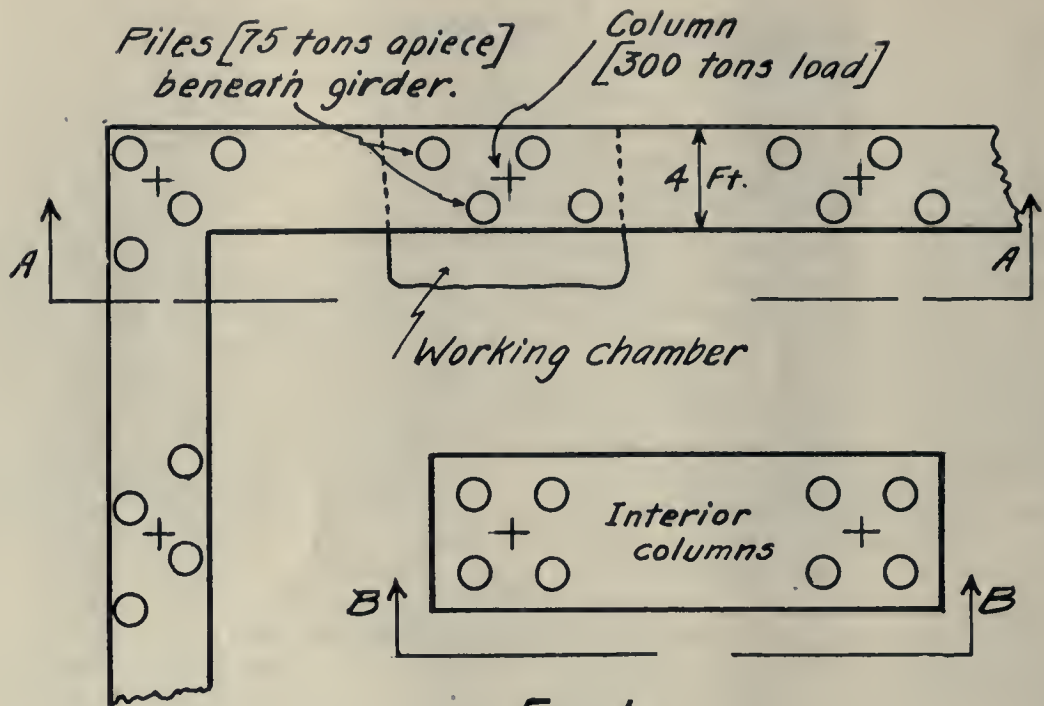


FIG. 1.
PLAN.

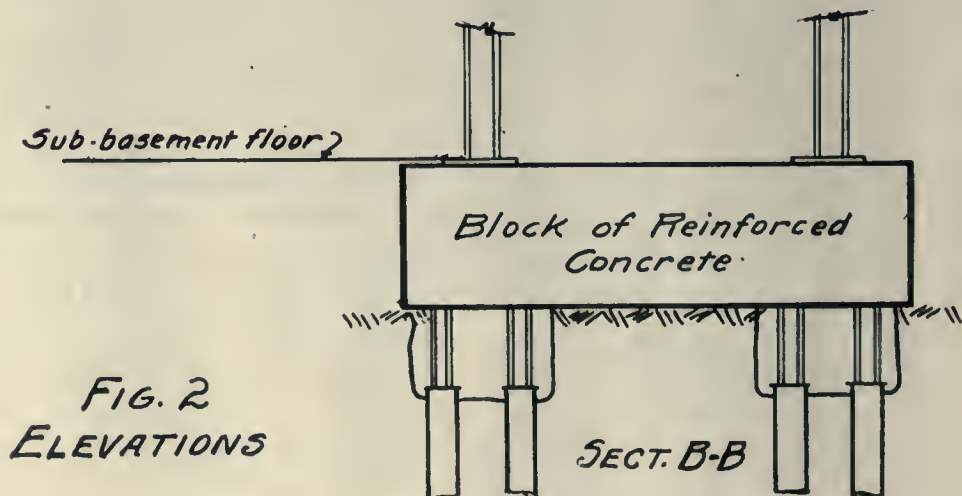
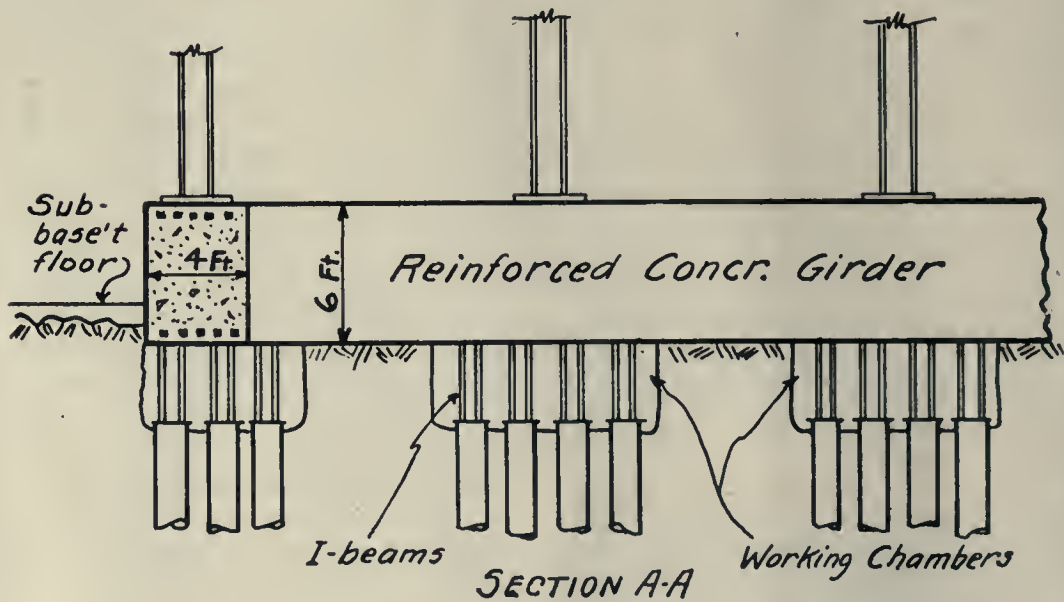


FIG. 2
ELEVATIONS

AN INVESTIGATION OF THE ONE-HINGED ARCH AND ITS COMPARISON WITH OTHER TYPES

By NEE SUN KOO, B. S., M. C. E. (1919).
McGraw Fellow in Civil Engineering, 1920-21.

An Abstract of a Thesis to be Presented to the Faculty of the Graduate School of Cornell University for the Degree of Doctor of Philosophy.

(Continued from the March Issue)

Formulas for Reactions of Three—Two—And No-Hinged Arches

General formulas for reactions of three-, two-, and no-hinged arches have been derived in order to obtain a comparison between them. They have also been applied to these types of arches with parabolic, elliptical, and segmental circular ribs. Table 3 shows a comparison of the general formulas of the four types of arches, while those for a comparison of the reactions of parabolic, segmental circular and elliptical forms of arches are not here reproduced.

The Envelop of Reaction Lines

The position of live load for the maximum positive and negative moments and the maximum positive and negative shears of the one-hinged arch can be found graphically by means of the reaction locus and the envelop of the reaction lines. Since the ends of the one-hinged arch are fixed, we cannot tell where the reaction lines pass through the support for a load at a certain point of the span. By means of the reaction envelop and the reaction locus, this can be easily done by drawing the tangent line to the reaction envelop from the point where the load line intersects the reaction locus. The equation of the reaction envelop of the one-hinged arch was found by the author to be an equation of the third degree. To plot the curve from the equation involves a tremendous amount of labor. It is easier to draw the reaction envelop from the computed values of ordinates than to plot it from the equation. The envelop passes through the hinge and intersects the Y-axis at a certain distance below the origin. To determine the points of division of the live load for the maximum positive and negative moments, tangent lines are drawn to the envelop from the point on the arch-rib we wish to investigate. The intersection of the tangent lines with the reaction locus gives the required points of division. To determine the points of division for the shear, a tangent line to the envelop is drawn perpendicular to the normal line of the section. The intersection of this tangent line with the reaction locus forms one division point, while the section itself is another division point.

Study On Designs

The design of a one-hinged arch can only be made with a series of approximations. Stresses due to temperature and rib-shortening play an important

part. These can not be exactly determined without knowing the area of the cross-section of the arch-rib. Yet the latter again depends upon the total stresses to be carried. The method of trial is the only way to secure the right section for the one-hinged arch-rib. Three comparative designs were made by the author in order to study their comparative merits: (1) The moment of inertia at any section of the arch-rib is assumed to vary as the secant of the angle of inclination of the section, with the effect of rib-shortening neglected; (2) Same assumption as in the first case, with the effect of rib-shortening included; and (3) the true moment of inertia of the section is used.

A one-hinged arch of twenty panels, with a span of 258 feet and a rise of 26' was adopted for investigation. The dead load is assumed 59 kips and the live load 18.5 kips per panel load. The depth of the rib at the center is assumed 5 feet. An allowance of 75° F is made for the rise or fall of temperature. The Modulus of elasticity is taken as 26,000 kips and the unit-stress for the gross section of the flanges, 15 kips. The arch chosen for investigation has been greatly studied by former graduate students of Professor H. S. Jacoby when containing three, two or no hinges. The reason for using this arch by the author is, of course, to compare the design of the one-hinged arch with that of the other types.

Study On Deflections

The deflections of the one-hinged arch were studied in three ways: (1) Vertical and horizontal deflections under the vertical loading; (2) vertical and horizontal deflection under the horizontal loading; and (3) maximum and minimum deflections. The same arch used in the design was used for the study of deflections. The deflections of this arch having three, two and no hinges respectively were investigated by Dr. P. H. Chen, a graduate of Cornell University. It gives a good opportunity for critical comparisons. (See The Cornell Civil Engineer, Vol. 26, Page 229).

RESULTS OF INVESTIGATION

Discussion On Formulas

So far as the formulas for the reactions of the one-hinged arch are concerned, those for the parabolic ribs are the simplest in form, while those for the segmental circular form require a vast amount of

labor for their derivation and application. Formulas for the elliptical form are intermediate in these respects.

Neglecting the effect of the axial thrust and using a ratio of the rise to the span for a segmental circular arch equal to 1-8, the relative effect of temperature upon the three forms of the one-hinged arch is as follows:

| | Parabolic | Elliptical | Seg. Circular |
|----------------------------|-----------|------------|---------------|
| Coefficient of $Eet/10h^2$ | 7.5 | 8.4 | 6.0 |
| Ratio | 125 | 140 | 100 |

The temperature effect in the parabolic form is 125% as great, and that in the elliptical form 140% as great as that for the segmental circular form. The effect upon the elliptical form is 112% as great as that upon the parabolic form. Thus, the temperature effect upon the elliptical form is the largest, while that upon the circular form is the smallest. It is to be noted that in the segmental form the ratio of the rise to the span is assumed as one-eighth. This is only a particular case. If we assumed another ratio, the results would be different.

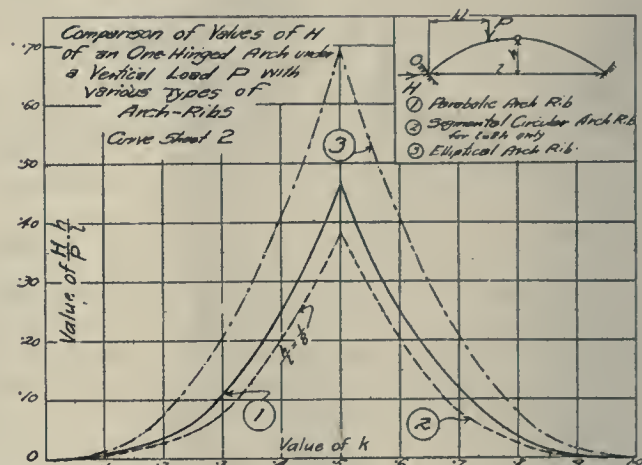
The relative effects of rib-shortening upon the horizontal reaction and the end moments of the three forms of one-hinged arches have the same relations as the temperature effects.

There is an interesting fact about the number of equations required to analyze no-, one-, two-, and three-hinged arches. Three-hinged arches require three conditions; two-hinged arches, four; one-hinged arches, five; and no-hinged arches, six. Thus, we see that the more hinges an arch has, the less are the number of the conditions required to solve its unknowns. In addition to the three statical conditions, the three-hinged arch requires no-elastic condition for its solution; the two-hinged arch requires one; the one-hinged arch, two; while the no-hinged arch requires three. Therefore the three-hinged arch is said to be statically determinate.

The formulas for reactions of three-hinged arches are exact, while those for no-, one-, and two-hinged arches are subject to many imperfections and assumptions. First of all, the elastic limit is not assumed to be passed. If very large loads should ever be applied which cause the stresses to exceed the elastic limit of the material in any member, the theory of elasticity fails and it is impossible to predict the degree of safety of the structure. The moment of inertia of any section of the rib is assumed to vary as the secant of the angle of the inclination of the arch-rib. The modulus of elasticity is assumed to be constant throughout the span. Shear is neglected in the derivation of the formulas.

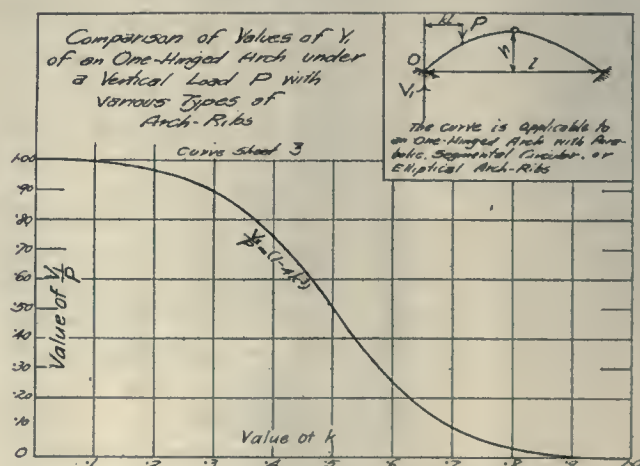
No- and one-hinged arches are similar in one respect; that is, they are both subject to vertical and horizontal reactions and have end moments under either vertical or horizontal loads. Two- and three-hinged arches are all subject to vertical and horizon-

tal reactions, the vertical reactions being the same for those two types of arches under either vertical or horizontal loads. Temperature and rib-shortening cause horizontal reactions and the end moments in both the one and no-hinged arches, while in two-hinged arches they cause horizontal reactions but no end moments. It is generally supposed that a three-hinged arch is not subject to stresses due to a change in temperature. Strictly, however, such stresses will occur, for a fall in temperature causes a deflection of the crown hinge, and as the span does not change, the horizontal thrust will be increased. The stresses produced, however, are very small.



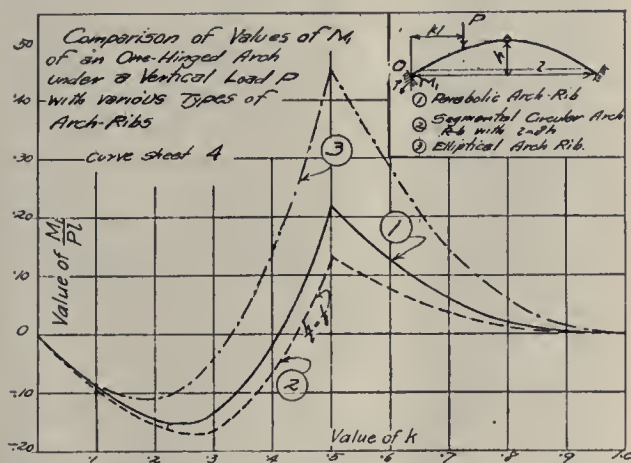
Neglecting the effect of axial thrust upon the rise and fall of temperature, the relative importance of temperature effects upon the horizontal reactions and end moments of no-, one-, two-, and three-hinged arches are as follows:

| Arch | No-Hinged | One-Hinged | Two-Hinged | Three-Hinged |
|------------|-----------|------------|------------|--------------|
| ELLIPTICAL | | | | |
| H_1 | 160/8 | 67.2/8 | 12/8 | 0 |
| M_1 | 125.6/8 | 67.2/8 | 0 | 0 |
| PARABOLIC | | | | |
| H_1 | 90/8 | 60/8 | 15/8 | |
| M_1 | 60/8 | 60/8 | 0 | 0 |



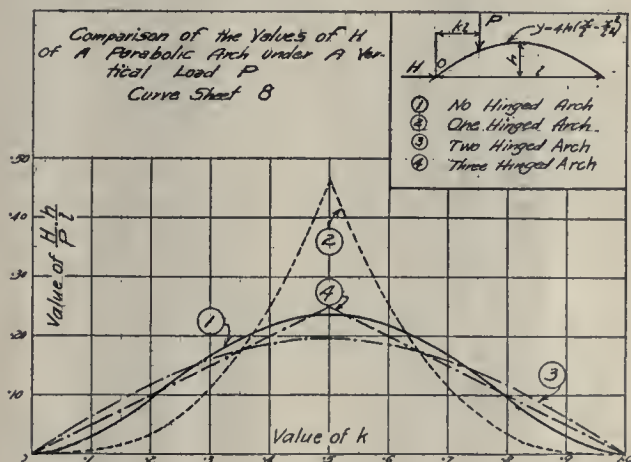
Thus, the temperature effect upon the no-hinged arch is found to be the greatest of all. Referring

to H in the parabolic form, it is one and one-half times as large as for the one-hinged arch, and six times as large as for the two-hinged arch. In the elliptical type it is 2.38 times as large as that for the one-hinged arch, and 13.33 times as large as for the two-hinged arch. The temperature effect upon H of the one-hinged arch of the parabolic form is four times as large as for the two-hinged arch, while for the elliptical form it is 5.6 times as large. The temperature effect upon M of the no- and one-hinged arches is the same in the parabolic form. In the elliptical form, the former is 18.7 times as great as the latter. In the segmental circular form, the temperature effect upon H in the one-hinged arch is three times as great as that for the two-hinged arch.



With respect to the effect of rib-shortening the relative ratios above stated apply to different types of arches equally well.

So far as the formulas for the reactions are concerned, there is a decided advantage gained by those for the parabolic form over all other types of arches because of their simplicity.

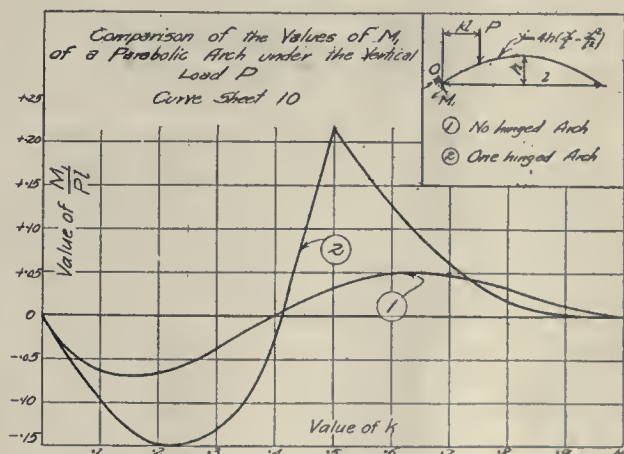
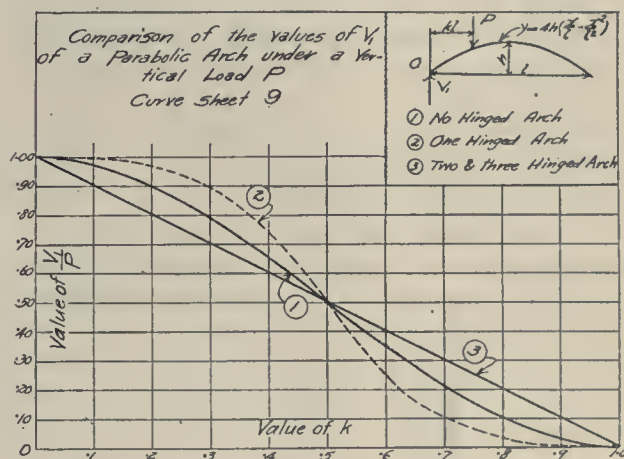


Discussion on Reaction Influence Lines

In order to study the variation of the reactions and the end moments as a single load moves over the span, reaction influence lines are drawn and compared. (See diagrams 2, 3, 4, 8, 9, and 10).

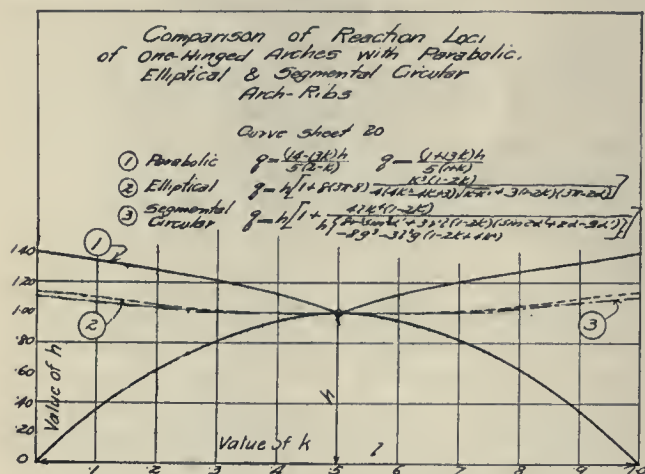
Only a few of the numerous diagrams are reproduced in the abstract of the thesis.

Under vertical loading, the elliptical form of the one-hinged arch has greater horizontal reactions and end moments than the parabolic and segmental circular forms. The last two forms cause less difference in the H_1 and M_1 . The vertical reactions are all the same in the one-hinged arch for the three forms of ribs. There is not much difference shown under the horizontal loading. The circular form seems to have the greatest advantage for the one-hinged arch judging from a comparison of the curves. However, the curves for the circular form are only drawn for a single case with a ratio of rise to span equal to 1-8. If other ratios were used, the results may be different. On the other hand, the parabolic form has the advantage of low reactions besides that of simplicity in formulas. Therefore, the author comes to the conclusion that the parabolic curve is the best form for the neutral axis of the arch-rib to be used for a one-hinged arch.

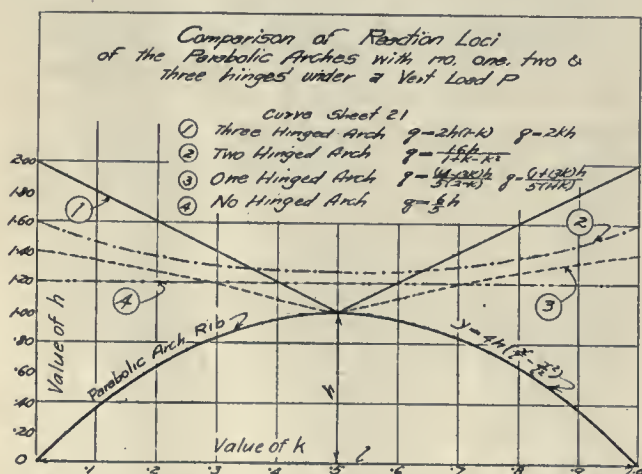


Under vertical loading the reaction influence line of H for a three-hinged arch consists of straight lines; for a two-hinged arch, a curve resembling a parabola; for a no- and a one-hinged arch, curves symmetrical at the center. Curves for one- and three-hinged arches break at the crown while those for no- and two-hinged arches do not. This is because the hinge at the crown of the one- and three-

hinged arches breaks the continuity of the rib. Curves of no-, two-, and three-hinged arches are very close to each other, while that for the one-hinged arch has a great variation, being lower at the supports and higher near the crown. This brings out one disadvantageous fact for the one-hinged arch. When the load is at the crown, the value of H is about two times as much as that for the other types. This means that the supports have to resist a greater horizontal thrust, and extra care has to be taken in making the end supports secure. The end moment of the one-hinged arch has a greater variation than that of the no-hinged arch.



The one-hinged arch has an advantage over the no-hinged arch with regard to the effect of temperature and thrust, but it is not so favourable with regard to the reactions and the end moments under vertical loads. For reactions due to temperature, thrust and vertical loading, the one-hinged arch is not as advantageous as the two- and three-hinged arches. So far as the simplicity of the formulas for



the reactions is concerned, the same statement holds true. However, attention will be called subsequently to some decided advantages of the one-hinged arch.

Discussion On Reaction Loci

In order to compare the reaction loci of different types of arches, the equations of the reaction loci

for no-, one-, two-, and three-hinged arches are plotted for different forms of arch ribs. They are shown in diagrams 20 and 21.

All reaction loci for the one-hinged arch with different forms of arch-ribs pass through the crown hinge. When the load is at the crown, the reaction lines must pass through the crown hinge, for otherwise there would be rotation at the crown. All reaction loci break their continuity at the crown but the two halves are symmetrical. The parabolic one-hinged arch has the highest ordinate when the load is near the support, while the segmental circular form has the least ordinate.

For a parabolic arch-rib, the reaction locus of the three-hinged arch is a straight line for each half of the span; that for the two-hinged arch, a curve like a parabola; that for a no-hinged arch, a horizontal straight line at an ordinate of $1.2h$; and that for the one-hinged arch, a curve breaking at the center. (Curves for no- and two-hinged arches are continuous, while those for the other two break at the center. Curves for no- and two-hinged arches do not pass through the crown, while those for the one- and three-hinged arches must do so. At the support, the three-hinged arch has a maximum ordinate of $2.00h$; the two-hinged arch, $1.60h$; the one-hinged arch, $1.40h$; and the no-hinged arch, $1.20h$. At the crown the curve for the two-hinged arch has the highest ordinate.

Similar statements can be drawn for the reaction loci for the elliptical forms of arches. The ordinates are highest in certain cases and lower in others, while the general forms are about the same.

Discussion On Reaction Envelop

By means of the reaction locus and the reaction lines, the position of live loading for the maximum positive and negative moments and maximum positive and negative shears for the one-, two-, three-, and no-hinged arches can be found graphically. In the three- and two-hinged arches, the reaction lines can easily be drawn as soon as the position of the live load is given; because the hinges at each support fix the direction of the reaction lines. In the one- and no-hinged arches, the reaction lines cannot be so easily drawn, if the position of the load is only given; for the fixing of the supports makes the direction of the reaction lines uncertain. In order to avoid the difficulty, reaction envelopes are required for both the one- and no-hinged arches.

The reaction envelop of the no-hinged arch was found by A. V. Saph, a graduate of Cornell University, to be two hyperbolas symmetrical and tangent to each other at the center at a point $2.3h$ above the level of the supports. The reaction envelop of the one-hinged arch was found by the author to consist of two curves very similar to those for the no-hinged arch in form yet quite different in their equations. The curves are symmetrical and meet each other at the crown hinge. The reaction en-

velop is a plane curve of the third degree; because the formulas of the reactions of the one-hinged arch involves the k 's in the fourth power. In the case of the no-hinged arch, the k 's in the formulas of the reactions are of third power; hence a second-degree curve is obtained for the envelop.

The method of finding the positions of live loading is the same for the four types of arches, except that the reaction envelops of the no- and one-hinged arches have the function of the end hinges in the case of the three- and two-hinged arches. A comparison of the reaction envelops of the no- and one-hinged arches is given in diagram 28.

Discussion On Design With the Moment of Inertia Varying As the Angle of Inclination of the Arch-Rib

There is no marked difference in the procedure of designing the arch-rib for the two-, one-, and no-hinged steel arches with the assumption that I varies as $\sec \theta$. The procedure may be generalized in the following heads: (1) calculation of reactions and end moments from the formulas for a unit load at each panel point; (2) to find the position of live loading for maximum positive and negative moments, by either algebraic or graphical methods; (3) calculation of dead load and live load moments for each section; (4) calculation of dead load and live load thrust; (5) calculation of moments and thrust due to temperature effect by assuming a certain moment of inertia at the crown; (6) calculation of moments and thrust due to effect of rib-shortening by means of the assumed moment of inertia; (7) design of the flange area of the crown section using the maximum moments and thrusts so obtained; (8) test the moment of inertia of the crown section, and see if the assumed value of the moment of inertia at the crown section agrees with the value obtained; (9) after the right value of I_0 is obtained the flange areas at other sections can be calculated by using the relation that $I = I_t \sec \theta$; (10) the position of live load for maximum positive and negative shear is obtained by either graphical or algebraic method, the maximum shear at each section is secured by combining the dead load, live load, temperature and rib-shortening shears, and the webs are designed accordingly. The design of the three-hinged arch may be carried out in the similar order with the exception that no trial is required in securing the sections.

There is an interesting fact found in combining the moments and thrusts caused by the dead load, live load, temperature and rib-shortening to produce the maximum stress on the sections of the one-hinged arch. The live load may be considered in three ways; (1) loading for maximum positive moments; (2) loading for the maximum negative moments; (3) loading for maximum thrust. In the design with the effect of rib-shortening neglected, case (1) controls for the section 0-4 and case (3) controls for the section 5-10. In the design with

the effect of the rib-shortening included, case (2) controls for the section 0-4, while case (3) still controls for the sections 5-10. The reason is quite clear; for in the sections near the center, the moments are comparatively small, while the thrusts are large. This means that a full live load is required to design the sections near the center. As there exist large bending moments in the sections near the support, naturally the moments control the design for those sections. The effect of rib-shortening is to produce the negative moments and thrusts. This is why the negative moments control the end sections when the effect of the rib-shortening is included. The design of the one-hinged arch is different from that of the two-, and no-hinged arch in two respects. The design of the center sections of the one-hinged arch is controlled by the thrust while that of the two- and no-hinged arches is controlled by the moments. The reason is because the no-hinged and two-hinged arches have large moments at the middle sections, while the one-hinged arch has large thrusts. The signs of the moments and thrusts produced by the effect of temperature and rib-shortening are the same for all sections of the one-hinged arch, while those for the no-hinged arch are the same for the sections below 2-3 h of the rib, and opposite each other for the sections above 2-3 h of the rib. The signs of the moments and thrusts produced by the effect of temperature and rib-shortening are all opposite for the two-hinged arches.

In designing the sections at the crown, only thrust is used for the one-hinged arch. This makes the design of the one-hinged arch easier, because the right value of the moment of inertia can be secured immediately.

Positive shear governs the design of the web for all types of arches, whether the effect of rib-shortening is included or not. The latter which tends to produce negative thrust, tends to increase the positive shear in all sections for the one-hinged arch.

Under maximum loading the comparative effects of dead load, live load, temperature and rib-shortening on the flanges are shown in the following table and also on curve sheet 22:

| Section | Dead load Per Cent. | Live load Per Cent. | Tempera- ture Per Cent. | Rib- shortening Per Cent. |
|---------|---------------------------|---------------------------|-------------------------------|---------------------------------|
| 0 | 31.5 | 29.7 | 24.2 | 14.6 |
| 1 | 38.8 | 24.2 | 23.0 | 14.0 |
| 2 | 47.4 | 17.7 | 21.7 | 13.2 |
| 3 | 58.2 | 10.6 | 19.3 | 11.9 |
| 4 | 72.7 | 1.3 | 16.1 | 9.9 |
| 5 | 75.8 | 23.7 | 20.6 | —20.1 |
| 6 | 75.9 | 23.8 | 15.5 | —15.1 |
| 7 | 76.0 | 23.8 | 11.4 | —11.1 |
| 8 | 76.0 | 23.9 | 8.5 | — 8.4 |
| 9 | 76.0 | 23.8 | 6.6 | — 6.5 |
| 10 | 75.8 | 23.8 | 6.3 | — 5.9 |

It is seen from the curve that the dead load has the greatest effect of all, and its effect on the sections near the center is greater than those near the ends. In the first place, this is because the dead panel load is comparatively great, and naturally it takes greater stress. In the second place, the effect of temperature and rib-shortening near the center sections is greater than their effect on the sections near the ends. This makes the percentage of the stress carried by the dead load gradually decrease in the sections near the ends. The live load is the next important factor in causing flange stresses. The effect of temperature and rib-shortening can never be omitted. They have about the same effect. Temperature has the greater effect in the sections near the ends than in those near the center. The same is true for the rib-shortening. The negative signs of the rib-shortening in the sections near the ends are explained by the fact that both negative thrusts and moments are used.

Under maximum loading the comparative effects of moments and thrusts on the flanges is shown in the following table and also shown on curve sheet 23:—

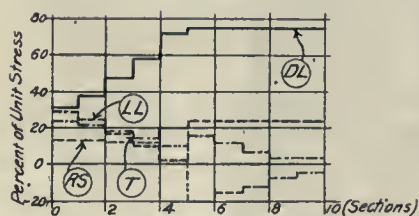
| Section | Moment Per Cent. | Thrust Per Cent. |
|---------|---------------------|---------------------|
| 0 | 73.1 | 26.9 |
| 1 | 67.4 | 32.6 |
| 2 | 60.3 | 39.7 |
| 3 | 51.8 | 48.2 |
| 4 | 43.1 | 56.9 |
| 5 | 2.5 | 97.5 |
| 6 | 1.5 | 98.5 |
| 7 | .7 | 99.3 |
| 8 | .4 | 99.6 |
| 9 | .1 | 99.9 |
| 10 | .0 | 100.0 |

One apparent conclusion can be drawn from the curve; that is, the moment has far greater effect on the sections near the ends than the thrust, while the thrust has far larger effect on the sections near the middle than the moment. The effect of moment on the sections 5-10 is practically nothing. As a whole, the thrust is more important than the moment. This peculiar fact is a special feature of the one-hinged arch.

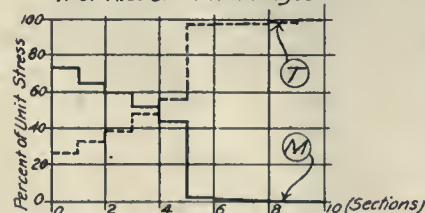
The comparative areas of the designs with the assumption $f = \sec \theta$ with rib-shortening included and neglected are shown in the following table and on curve sheet 24:—

| Section. | Rib-Shortening Neglected. Area in sq. in. | Rib-Shortening Inc. Area in sq. in. |
|----------|---|---|
| 0 | 166.69 | 153.70 |
| 1 | 142.77 | 127.00 |
| 2 | 121.39 | 103.60 |
| 3 | 105.00 | 84.00 |
| 4 | 88.84 | 67.75 |
| 5 | 82.15 | 67.70 |
| 6 | 77.39 | 66.80 |
| 7 | 73.72 | 66.00 |
| 8 | 71.10 | 65.45 |
| 9 | 69.38 | 64.95 |
| 10 | 68.71 | 64.71 |

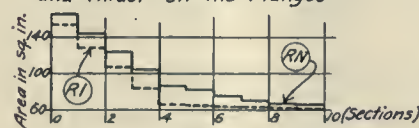
It is seen from the curve that the one-hinged arch requires far larger areas in the sections near the ends than the sections near the crown. This is due to the presence of the large end moments. It is also seen that the effect of rib-shortening is to decrease the areas of sections. We thus see that for this particular rise of span, the effect of rib-shortening can be safely but not economically neglected in the design. The author believes that this is equally true for other ratios of rise to span, because in any



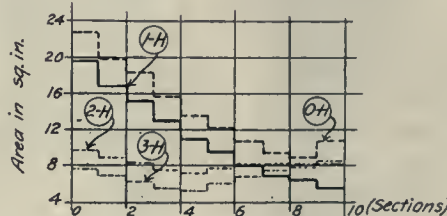
Comparative Effects of D.L., L.L., T. & R.S. on the Flanges



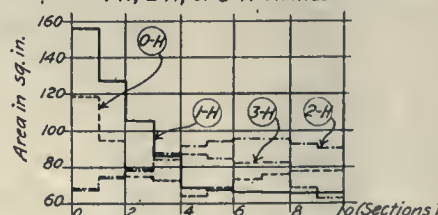
Comparative Effects of Moment and Thrust on the Flanges



Comparative Design of Flange Areas



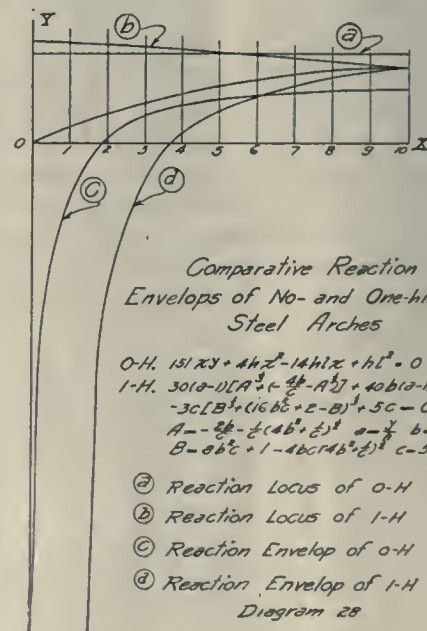
Comparative Web Areas of 0-H, 1-H, 2-H, & 3-H Arches



Comparative Flange Areas of 0-H, 1-H, 2-H, & 3-H Arches

Curves Nos. 22-26

DL = Dead Load, LL = Live Load, T = Temperature
RS = Rib-Shortening neglected, RI = Rib-Shortening included.



Comparative Reaction Envelops of No- and One-hinged Steel Arches

$$\begin{aligned}
 0-H. & 151XY + 44x^2 - 144lx + 4l^2 = 0 \\
 1-H. & 3018-11[A^3 + (4b^3 - A^3) + 40b(2-1) \\
 & - 3C(B^3 + (16b^3 + 2-2) + 5C - 0 \\
 & A = -\frac{2b}{3} + \frac{1}{3}(4b^3 + 2) \quad a = \frac{2}{3} \quad b = \frac{4}{3} \\
 & B = 8b^2 + 1 - 4bC(4b^3 + 2) \quad C = 5014b-7
 \end{aligned}$$

- (a) Reaction Locus of 0-H
- (b) Reaction Locus of 1-H
- (c) Reaction Envelop of 0-H
- (d) Reaction Envelop of 1-H

Diagram 28

(Continued on page 140)

THE CORNELL CIVIL ENGINEER

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COLLEGE NOTES

C. E. Association Meeting On Wednesday evening, March 23, 1921, the Association of Civil Engineers of Cornell University held one of its rather irregular meetings at the Barnes Hall Coffee House. In the absence of our President, T. C. McDermott, '21 who was practicing for the Michigan Track Meet and in the loss of our Vice-president, D. G. Cockeroff through graduation this February, the Chair was taken by J. J. Chavanne, '21 Secretary. V. S. Onstott was elected Vice-president of the Association to succeed Cockeroff.

The one most important transaction of the meeting was the decision of the Association to apply for membership as a Student Chapter in the American Society of Civil Engineers. A detailed account of the affairs leading up to this decision may be found below.

Plans and preparations for the annual Civil Engineering Banquet to be held at the Hotel Ithaca during the early part of May were discussed. The question as to whether or not the Civil Engineering students should put on a show at the Spring Day Circus also came up for consideration and a committee was appointed to take charge of the matter. Several stunts by undergraduates and others enlivened the meeting. After the discussion ended, the meeting adjourned to the refreshment room in the Coffee House where the members partook of doughnuts and coffee, and the proverbial "good time was had by all."

238 Students Dropped from the University

retary's office.

A marked decrease of 20% over last year's total was the most important conclusion drawn from the official figures recently given out by the Secretary's office.

At the completion of the first term, 238 students were dropped from the rolls of the secretary as against 298 at the corresponding time last year. Among those forced to leave the university owing to delinquency in their studies, 18 were members of the College of Civil Engineering. Of these, the various classes were represented as follows: 1921, 1; 1922, 10; 1923, 7. The 1924 class list was combined with that of M. E. so that separate figures for the college are not obtainable.

Intercollege Baseball With Spring here to stay once more, Capt. Chavanne of the College baseball team will issue a call for candidates for the team within the next few days. This will give us the first chance for the revival of the college spirit which has until very recently been so lacking among our men. Incidentally it will also give us a good chance to win another college championship. Let's see what we can do. Let's go!

The Wrestling Season Considering the fact that the Cornell wrestling team was for the most part made up of new men, it had a very successful season, winning four out of six meets and securing second place in the title meet. On January 22, Cornell was defeated by Pennsylvania. In this meet, on account of injuries to the Cornell heavy-weight entry, E. L. Maier, C. E. '21, a 158 pound man, entered in this class and during the bout received a broken leg, which made it necessary for Cornell to forfeit this bout. On its second week-end trip the Varsity gained a decisive victory of 25 to 4 over the Brooklyn Polytechnic Institute, gaining all its points on falls; and it came out on top of the Columbia team by a score of 21 to 9. In the Lehigh meet at Ithaca, it

was victorious over Lehigh in an exciting and close match. The last bout decided the meet and Hanson of Cornell won it. When the varsity met Penn State the following week however it did not fare so well. Although the final score was 19 to 6 in State's favor, the Cornell team put up a game fight as was shown by the fact that Penn State obtained only two falls. This meet showed that Cornell was Penn State's strongest opponent for championship honors, since, before meeting Cornell, they had lost but one match in five meets. On March 5, the Varsity won its last home meet against Brown by a score of 19 to 6. The title meet was held at Princeton on Saturday, March 19, the preliminaries being held the day before. With only two men in the finals, the Varsity won one first place, and three second places, thus scoring 13 points, two more than Princeton and three more than Yale who took third and fourth places. Penn State won the meet with a score of 28. McBride of Cornell furnished the biggest surprise of the day when he threw Captain Ashby of Penn State in the 158 pound class, thereby gaining the Intercollegiate championship in that class.

By obtaining seven out of a possible ten first places, in a dual track meet between Cornell and Michigan at Ann Arbor, the Wolverines clinched victory from the visiting Red and White aggregation. This victory more than retaliated for the defeat suffered at Cornell's hands in Ithaca last year. Michigan has now six dual track meets to its credit as against five for Cornell as a result of their various meets.

The Wolverines showed their greatest superiority in the sprints and low hurdles, where they captured 17 out of a possible 18 points. The relay, which was expected to decide the meet, also went to Michigan by the narrow margin of six feet. The Ithacans showed to their best in the one mile event, when they flashed across the line in the first three places. The hurdles proved to be an even break, Michigan having a slight advantage in the low while Cornell garnered first and second in the high hurdles.

Although little has been heard either of crew practice or of our prospects on the water, this year things are reputed to look pretty bright for the Red and White. Coach Hoyle, successor to the "Grand Old Man of Rowing," as the New York Dailies were wont to call him, has had the men at work on the machines in the Old Armory all winter, and has been rounding into condition what appears to be, at least to the eye of the uninitiated, a championship squad. On March the seventh the first outdoor practice of the year was held, when six combinations of Varsity and Freshman Crews were

taken down to Courtney Inlet. Since then the Varsity have been on the water regularly, and the machines have been used exclusively by the candidates for the intercollegiate crews.

Intercollegiate rowing has suffered a revival which bids well for a series of exciting races on Spring Day. There are over 175 candidates for the various combinations, and Coach Atkinson has stated that close competition is expected for positions on the various crews. The C. E. College has several very promising candidates, and from the looks of things at present our crew should prove a strong aspirant for the honors of the Spring Day Race.

Graduate Manager Romeyn Berry has announced the various Varsity and Freshman schedules for the season which are as follows:

May 21—Spring Day—Yale and Princeton Varsity and Freshmen on Lake Cayuga.

May 28—Harvard Varsity and Freshmen on the Charles River Basin.

June 22—Intercollegiate Regatta at Poughkeepsie.

There may also be a Junior Varsity race, with Yale and Princeton on Spring Day, and three crews will be entered in the Intercollegiate Regatta on the Hudson. The men have been showing up very well and a very successful season is expected.

Spring Football practice started at Cornell on Wednesday, March 23, 1921, under the direction of Coach Gilmore Dobie.

Previous to issuing his call for candidates Mr. Dobie made a statement to the effect that Cornell will never have a championship football team until football has as much call on the services of the star athletes as track and crew has.

Between 90 and 100 men responded to Coach Dobie's call and heard him outline his program for spring training. The practice will last for five weeks not including the spring recess. The daily workouts will be entirely rudimentary and will consist mostly of passing, kicking, and handling the ball. A small amount of scrimmage will probably be included towards the end of the practice season.

Polo, as a Cornell Sport, started on Saturday, March 19 after a meeting of the candidates had been held in the New Drill Hall. Major Christian, who is head of the Field Artillery Department of the R. O. T. C., has charge of polo at Cornell. On Thursday, March 24 twenty thoroughbred polo ponies which have displaced the artillery mounts which the polo squad had been using up until then arrived in Ithaca from the remount station at Front Royal, Va. The ponies, which are from the very best stock that it is possible to obtain through army channels, are about three years old, and average about 900 pounds in weight.

ALUMNI NOTES

'73. Henry Everett Blake is Assistant Engineer, State Highway Department, at 53 Lancaster Street, Albany, N. Y.

'81. Henry W. Battin is Superintendent of Winston Brothers Company, Minneapolis, Minn. He lives at 1964 Kenwood Parkway.

'88. Edward J. Duffies, U. S. Assistant Engineer in the War Department in Washington, gives his address as 2412 12th Street, N. E., Washington, D. C.

'93. Herman M. Freeman advises us that he is continuing as Assistant Engineer of West Orange, N. J., with offices in the Town Hall. His address is 61 South Valley Road, West Orange, N. J.

'96. George O. Wallhauser writes us that he is now living at 825 W. 180th St., New York City.

'97. John C. Hoyt of the U. S. Geological Survey visited the college recently. He expects to enter his son Kendall in the Engineering College next year.

'00. Edwin W. Gehring is a Physician at 284 Ocean Ave., Portland, Me.

'01. Edgar T. Brown is a Civil Engineer at Clarksburg, W. Va. His mail address is P. O. Box 747, Clarksburg, W. Va.

'01. Ralph F. Proctor, Chief Engineer of the Maryland Company of Baltimore, Md., gives his address as 143 West Tamale St., Baltimore, Md.

'03. Frederick W. Fisher is employed by the Rochester Gas & Electric Corporation, 34 Clinton Ave. N., in the Capacity of Employment and Safety Manager. He was formerly with the Rochester Railway and Light Company in a similar position.

'04. R. Elmer Curtiss is a member of the firm of Curtiss & Dean, Contractors & Civil Engineers, at 721 Main St., Hartford, Conn. His home address is 41 Sumner St., Hartford, Conn.

'04. Guernsey W. Ellis is Assistant Engineer in the N. Y. State Highway Department, Federation Building, Hornell, N. Y. He lives at 3 Olive Place, Hornell, N. Y.

'05. Don E. Andrews is a fruit grower at Fairhope, Alabama. He writes that Alfred V. Edge, '06, has just returned to New York, via Europe, from the Netherlands Indies, where he has been engaged for four years in Sumatra on the rubber plantations of the United States Rubber Company.

'05. Nora Stanton Blatch is a Builder with offices in the Liggett Building, New York City. Her home is in Greenwich, Conn.

'05. George A. Brown who is in the retail jewelry business at 307 Broadway Hannibal, Mo., is residing at 3300 St. Mary's Ave.

ex '06. L. B. Luppen is engaged in business in Sacramento as ventilating and heating contractor.

He is a member of the firm of Luppen & Hawley.

'06. Henry Ryon is employed by the New York State Department of Health at Albany, N. Y.

'06. Enrique Ruiz Williams was an interested visitor at the University recently, not having been here since 1915. Williams is a consulting engineer with offices at 408 Banco National Building, Havana, Cuba.

'07. Clarence de Clerq writes us that his address has been changed to 5 Hotchkiss St., Binghamton, N. Y. He is Assistant Engineer with the State Highway Commission.

'07. B. J. Finch notifies us that his address is 416 28th Street, Ogden, Utah. Finch was recently elected a Certified Member of the A. A. E.

'07. Frederick N. Goepel gives his address as 46 Riverside Drive, New York City.

'07. Elmer W. Sellstrom, Superintendent of the Dahlstrom Metallic Door Company, is chairman of the Executive Committee of the Jamestown (N. Y.) Engineering Society.

'07. Chester G. Wigley of Maplewood, N. J., formerly engineer of the New Jersey State Board of Health, was re-elected President of the New Jersey Sewage Works Association at its annual convention on February nineteenth.

'08. John Condon is Contract Manager for the Turner Construction Company, 1713 Samson St., Philadelphia, Pa. His home address is Cynwyd, Pa.

'08. Meyer Davis is a Contractor and Builder at 55 Liberty Street, New York City. He lives at 152 W. 118th St., New York City.

'09. Ralph M. Bowman is Assistant Purchasing Agent of the Otis Steel Company of Cleveland, O., with headquarters at 1140 Leader-News Building.

'09. Hiram G. Conger writes us that he is a clergyman at 740 Rush Street, Chicago, Ill. At present he has no permanent home.

'09. George D. Curtis is Cashier of the Morris-Plan Bank, 310 Cass Street, Tampa, Fla. His home address is First Avenue, Bayshore Boulevard.

'09. Leland L. Graham, member of the firm of Chapman & Graham, Inc., of Jamestown, N. Y., is a member of the Executive Committee of the Jamestown Engineering Society. He resides at 506 Winsor Street, Jamestown, N. Y.

'09. Arthur W. Harrington is a Hydraulic Engineer in the U. S. G. S., 704 Journal Building, Albany, N. Y. He is also President of the B. B. Culture Laboratory, Inc., Yonkers, N. Y. At present he is living in Slingerlands, N. Y. He has three children.

'09. John R. Haswell is a Drainage Engineer in charge of the Farm Mechanics Extension, Penn

State College, State College, Pa. He writes that Leland Rhodes is in the School of Engineering there.

'09. William H. Hilborn is County Engineer for Osceola County, Iowa. His address is Sibley, Ia.

'10. Wilmer A. Dehuff is now an Associate Professor at John Hopkins University in Baltimore, Md. His address is 203 E. 32d Street.

'10. Charles E. Erickson is in the contracting and lumber business at 317 Flage Building Annex, Seattle, Wash. He lives at 1616 East Howell Street.

'10. Lawrence Griffin is an Engineer with Jones & Laughlin Steel Co., Woodlawn, Pa. His address is 148 Taylor Ave., Beaver, Pa.

'10. Herman D. Hirsch is in South Africa for the United Steel Products Company.

'11. Andrew L. Ackhart, Engineer for the Boldt Construction Company, 6110 Euclid Ave., Cleveland, O., gives his address as 1864 E. 71st St., Cleveland, O. He is a member of the Cleveland Society of Engineers.

'11. Irving C. Clausz is Chief of Party with the C. & Y. Railroad, 613 Marion Building, Cleveland, O. His address is 1484 Westwood Ave., Lakewood, O.

'11. Herbert H. Conway is Branch Manager of the Hedrick Construction Company of New York City. He lives in Maplewood, N. J.

'11. Arvin J. Dillenbeck is a Contractor at 594 Ellicott Square, Buffalo, N. Y. He lives at 50 Wellington Road.

'12. George A. Belden is an Architect for the Central of Georgia Railway, Savannah, Ga. His home is at 119 W. Oglethorpe Ave., Savannah, Pa.

'12. Thomas W. Blinn is a Draftsman for the City of Detroit Street Railways. His home address is 749 Crawford Ave., Detroit, Mich.

'12. Harry H. Frank has resigned his position of Engineer with Hunting-Davis Company of Pittsburgh, and is now in the employ of the Concrete Steel Company, 971 Union Areade, Pittsburgh, as District Engineer. His home is at 753 Mellon St., Pittsburgh, Pa. He was elected an Associate Member of the A. S. C. E.

'12. Ray T. Gildea, who was formerly an Engineer with the C. & P. Telephone Company of Baltimore, is now a Telephone Engineer with the Maryland Public Service Commission, with offices in the Munsey Building, Baltimore, Md. His home address remains the same, being 5225 York Road, Baltimore, Md.

'12. Frank H. O'Rourke and F. A. J. Mack visited the college recently. Frank and his brother "Barney", '10, are in the contracting business at 430 Walnut Street, Philadelphia, Pa., and Mack is selling machinery at Rochester, N. Y.

'13. William H. Barnard, Jr., is Assistant Engineer with the Southern Railway Company, Charlotte, N. C. His address is 506 N. Poplar Street, Charlotte, N. C.

'13. Nathan W. Dougherty is a Professor of Civil Engineering at the University of Tennessee, Knoxville, Tenn. He lives at 1708 Yale Avenue.

'13. Abraham W. Fuchs is a Sanitary Engineer in the U. S. Health Service. He was formerly stationed at Cincinnati, O., but is now in Memphis, Tenn., where he may be addressed at 17 Court-house.

'13. Mr. and Mrs. Russell D. Welsh announce the birth of a son, Paulus, on February 16 at Baltimore, Md. Welsh is draftsman in charge of construction with the Pennsylvania Coal and Coke Corporation, Patton, Pa.

'14. Philip T. Coffey is a Captain in the Corps of Engineers. He is with the 6th U. S. Engineers at Camp Pike, Ark. His home address is 229 Newtown, Ave., Astoria, L. I.

'14. Frederic W. Conant has recently been transferred to the 3rd Engineers at Schoefield Barracks, Honolulu, T. H. He was elected a member of the A. A. E.

'14. Albert C. Dunn, who is a Highway Engineer with the U. S. Bureau of Public Roads, has been transferred from Washington, D. C., to Richmond, Va. His home is at 1725 Park Avenue, Richmond, Va.

'14. Charles H. Fowler is now with the Truseon Steel Company, 2541 Oliver Building, Pittsburgh, Pa. Mr. Fowler was formerly a Concrete Engineer with F. T. Ley & Co., Inc., at Fairmount, W. Va.

'15. Leon Blog, who has been an Industrial Engineer with the Goodyear Tire and Rubber Company at Akron, Ohio, is now with the California branch of the same company in the same capacity. He lives at 5419 Fountain Ave., Los Angeles, Calif.

'16. Henry A. Foster has left the employ of D. P. Robinson & Company, and is now employed by the New York Water Power Investigation, where he may be addressed c/o Parsons, Klapp, Brinekerhoff, & Douglas at 84 Pine Street, New York City. His home is at 205 Garfield Place, South Orange, N. J.

'16. Charles H. Olmstead is District Engineer with the Tennessee Department of Highways at Nashville, Tenn. His address is 327 Seventh Avenue, North. Olmstead has an article on Types of Highway Pavements in Tennessee in the February issue of Municipal and County Engineering.

'17. Robert E. Bassler, Aeronautic Engineer in the Bureau of Construction & Repair, connected with the Navy Department at Washington, is living at 3220 17th St., N. W., Washington, D. C.

'17. Lester P. Clark is an Engineer with the Standard Oil Company. He lives at 6024 Chabot Road, Oakland, Calif.

'19. John C. Gebhard is a "Student Engineer" with the Bethlehem Steel Bridge Corporation, at Bethlehem, Pa.

IRA W. McCONNELL, C. E. '97*Director of the A. S. C. E.*

In connection with the establishment of a Student Chapter of the American Society of Civil Engineers at Cornell, it is interesting to note that one of our alumni is a Director from District 1 (New York) of that organization.



IRA W. McCONNELL

Ira W. McConnell, was born in Schell City, Mo., in 1871, and was graduated from Cornell University with the degree of C. E. in 1897. For two years he served as instructor in the College of Civil Engineering at Cornell, and for one year as professor of civil engineering at the Missouri School of Mines. As contractor's superintendent for the Nash-Dowdle Co. he was employed for two years on railway terminal work in Chicago and municipal drainage work in New Orleans.

For six years following he was in the U. S. Reclamation Service; four years as construction and project-engineer on the Gunnison tunnel and on the Uncompaghere project, and two years as supervising engineer of the Central District in charge of Reclamation Service work in Oklahoma, Kansas, Colorado, Nebraska, Central and Southern Wyoming and South Dakota. This assignment included such notable projects as the Pathfinder dam, the North Platte project, the Grand Valley project in Colorado, the Belle Fourche project in South Dakota, and the Garden City project in Kansas.

In 1909 Mr. McConnell became chief irrigation engineer for J. G. White & Co., New York, and later vice-president and general manager of the Idaho Irrigation Co. at Richfield, Idaho. In February, 1912, he was employed by the Stone & Webster Engineering Corporation as consultant in connection with the design, construction and operation of public utilities, water powers, railways, steam power stations, industrial buildings, etc., and in 1917 he became chief engineer for Stone & Webster.

In 1916 he made a five months' study of general

business conditions in South America, the trip covering the developed portions of Brazil, Uruguay, Paraguay, Argentine, Chile and Peru. Mr. McConnell was works manager and assistant general manager for the American International Shipbuilding Corp. at the Hog Island Shipyard.

In 1918 he became vice-president of Dwight P. Robinson & Co., Inc., New York City.

In Memoriam**ELLIS DUNN THOMPSON, C. E. '76**

Died February 9th, 1920

Ellis Dunn Thompson was born at Newark, N. J., on October 6th, 1854, and after receiving his preliminary education, was graduated from the School of Engineering, Cornell University, in 1876, and read law from then until 1879. He was connected with the Engineering Department, United States Army, from 1879 to 1904, most of this time as Assistant Engineer. During this period he was with the Mississippi River Commission on construction of river improvements for three years; with the Engineer Office at Beaufort, N. C., for three years, in charge of dredging and jetty construction, and acted as Principal Assistant Engineer at Wilmington, N. C., with supervision of all works of improvement in North Carolina.

From 1894 to 1904 he served as Principal Assistant Engineer in the Philadelphia District, where he had charge of the reconstruction of Philadelphia Harbor, which involved dredging of 43,000,000 cu. yd. of material, filling League Island, Petty Island, etc., costing approximately \$15,000,000, the construction of the breakwater at the entrance of Delaware Bay involving 1,500,000 tons of stone at a cost of \$2,350,000, and the improvement of the Delaware River involving a great amount of dredging, jetty construction, bulkheads, etc.

From 1904 Mr. Thompson was engaged in private practice as a Consulting Engineer on river and harbor work, having been connected with many large projects, until the United States entered the war, when he became Engineer in Charge of Dredging for the Emergency Fleet Corporation, on which work he was engaged at the time of his death.

In this capacity he covered all the shipyards under the Emergency Fleet Corporation and had 140 dredging plants operating under his direction. It was one of the biggest pieces of work of this kind ever handled by one man in this country and involved unremitting labor on his part. Mr. Thompson probably had direct charge of more dredging than any man in the United States and his name was connected with many of the larger waterway improvements.

He was a man of great mental capacity and large attainments. He was a member of the Engineers' Club of New York, Cornell Society of Civil Engineers, and the University Club of Philadelphia.

Mr. Thompson was elected a Member of the American Society of Civil Engineers on February 1st, 1899.

AN INVESTIGATION OF THE ONE-HINGED ARCH AND ITS COMPARISON WITH OTHER TYPES

(Continued from page 134)

case the moments and thrust produced by the rib-shortening always have the same negative sign in the case of a one-hinged arch. This naturally tends to decrease the area of section required, if the area of section is controlled by the positive moments and thrust, in the design, as is usually the case in the one-hinged arch.

The comparative flange areas required for the three-, two-, one-, and no-hinged arches for the same form of the arch-rib under the same specifications are shown in the following table and on curve sheet 25. The areas given for the three-hinged arch are exact, while those for the two-, one-, and no-hinged arches are obtained from a design with the assumption $I \approx \sec \theta$ with the effect of rib-shortening included.

| Section. | Three- Hinged. | Two- Hinged. | One- Hinged. | No- Hinged. |
|----------|-------------------|-----------------|-----------------|----------------|
| | sq. in. | sq. in. | sq. in. | sq. in. |
| 0 | 68.0 | 68.4 | 153.7 | 119.5 |
| 1 | 73.0 | 72.8 | 127.0 | 93.1 |
| 2 | 78.2 | 78.1 | 103.6 | 75.9 |
| 3 | 82.4 | 85.0 | 84.0 | 72.3 |
| 4 | 84.4 | 90.7 | 67.7 | 65.0 |
| 5 | 84.1 | 93.1 | 67.7 | 67.9 |
| 6 | 81.2 | 94.9 | 66.8 | 72.8 |
| 7 | 77.7 | 94.8 | 66.0 | 76.9 |
| 8 | 71.0 | 92.3 | 65.4 | 78.4 |
| 9 | 65.0 | 89.3 | 64.9 | 78.3 |
| 10 | 64.0 | 89.0 | 64.7 | 77.3 |

So far as the areas of sections in the flanges are concerned, the three-hinged arch is the most favorable of all, while the no-hinged and one-hinged arch require the largest areas. The areas of the two-hinged arch are intermediate between them. The three-hinged arch requires the largest area at the quarter points; for the moments at those sections are the largest of all. The two-hinged arch requires the largest area in the sections near the middle for the same reason. The one-hinged and no-hinged arches require the largest areas in the sections near the ends, because the end moment is the dominating factor in those sections. In comparing the areas in flanges of the one- and no-hinged arches, we see that the one-hinged arch requires comparatively large areas in the sections near the ends and small areas in the sections near the crown. The areas near the crown of the one-hinged arch are rather uniform, because the thrusts at these points are large and about equal in magnitude.

The comparative theoretical web areas required for the three-, two-, one- and no-hinged arches with the same form of the rib and designed under the same specifications are shown in the following table and also in curve sheet 26:—

| Section. | Three- Hinged. | Two- Hinged. | One- Hinged. | No- Hinged. |
|----------|-------------------|-----------------|-----------------|----------------|
| | sq. in. | sq. in. | sq. in. | sq. in. |
| 1 | 7.91 | 10.04 | 19.59 | 22.83 |
| 2 | 6.95 | 8.98 | 16.76 | 19.88 |
| 3 | 6.31 | 8.20 | 14.95 | 18.22 |
| 4 | 5.77 | 7.67 | 13.03 | 15.51 |
| 5 | 5.45 | 7.45 | 11.10 | 13.58 |
| 6 | 6.10 | 7.61 | 9.55 | 12.08 |
| 7 | 6.95 | 7.92 | 7.95 | 10.87 |
| 8 | 7.61 | 8.11 | 6.89 | 9.70 |
| 9 | 7.97 | 8.12 | 6.45 | 9.18 |
| 10 | 8.13 | 7.96 | 5.75 | 10.46 |

It is seen that the no-hinged arch requires the largest web area, while the three-hinged arch, the least of all. The one-hinged arch requires smaller web areas than the no-hinged arch, while the two-hinged arch requires greater areas than the three-hinged arch. The no-hinged and one-hinged arches require larger web areas in the sections near the ends and smaller areas in the sections near the crown. This is due to the fact that the shear in the no-hinged and one-hinged arches is far greater near the ends than in the sections near the crown. On the other hand, the web areas of the three-, and two-hinged arches are rather uniform, since the shears in the sections of the three- and two-hinged arches are rather uniform. The marked difference is caused by the fixing of the supports in the one case, and the hinging of the supports in the other.

The following table shows the results of the design based upon the assumption $I \approx \sec \theta$

| Section. | Composition | Moment of Inertia. | Ratio of I. | Sec θ . | Proposed Assumption of I. |
|----------|--|--------------------|-------------|----------------|---------------------------|
| 0-2 | 6 Ls 6" \times 6" \times 9/16" 3 Pls 14" \times 9/16" 5 Pls 18" \times 7/8" 1 Pls 18" \times 3/4" | 286,000 | 2.49 | 1.07 | 250% |
| 2-4 | 6 Ls 6" \times 6" \times 9/16" 3 Pls 14" \times 9/16" 2 Pls 18" \times 3/4" 1 Pls 18" \times 13/16" | 190,600 | 1.59 | 1.05 | 160% |
| 4-6 | 6 Ls 6" \times 6" \times 9/16" 3 Pls 14" \times 9/16" 3 Pls 18" \times 5/16" | 123,800 | 1.03 | 1.03 | 103% |
| 6-8 | 6 Ls 6" \times 6" \times 9/16" 3 Pls 14" \times 9/16" 1 Pls 18" \times 1/4" | 121,700 | 1.02 | 1.01 | 101% |
| 8-10 | 6 Ls 6" \times 6" \times 9/16" 1 Pls 14" \times 9/16" 1 Pls 18" \times 3/16" | 119,700 | 1.00 | 1.00 | 100% |

It is seen that the assumption $I \approx \sec \theta$ is about right for the sections near the crown, and is in great error for the sections near the ends.

(Continued in the May Issue)



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DROP-FORGINGS
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PRETEST FOUNDATIONS

(Continued from page 128)

the simple elements in the design of a Pretest Foundation. No attempt has been made to reproduce an actual condition, with the complication of details required in any explanation of a particular case. But there has been chosen what might fairly represent the corner of a small office building, with exterior and interior columns. All column loads have been considered as 300 tons each, and the safe bearing power of each pile 75 tons, requiring, therefore, four piles to each column. The simple rules for the location of the piles are that each column shall be allotted the number of piles required to sustain its load, and that the centroid of each group of piles shall come directly beneath the corresponding columns. The absolute simplicity of this arrangement is its greatest recommendation, because expensive grillages to provide horizontal distribution of loads are absolutely avoided, and the supporting units are concentrated and placed just where they can be most effective.

The elevation drawing, fig. 2, shows the working chamber beneath the girder from which the piles are sunk by hydraulic pressure. The connection between the top of the pile and the under side of the girder is made by I beams tightened with steel wedges. It must be understood that the working chambers are finally filled in with concrete.

(Continued from page VIII)

THE DISADVANTAGE OF POOR LIGHTING.

As thousands of our industrial plants are operating to-day with poor lighting and in some cases with extremely bad facilities, it would seem that the importance of the subject of lighting has not been given the serious consideration by those responsible for such conditions.

Poor lighting is one of the most serious handicaps under which a manufacturing establishment can operate. First of all, poor lighting is the cause of a large number of accidents in industrial plants; and it is singular that accident reports do not yet properly classify the hazards of poor lighting, which in many cases is the primary cause of an accident attributed to what is really a secondary cause. Safety engineers and other officials who make accident reports should always consider the condition of the lighting when working up a report of accident causes, for it plays an important part in a great many casualties and is apt to be overlooked. All accidents due to poor lighting are accidents of neglect, and are preventable. The poor lighting accident hazard is clearly chargeable to management and not men. It is a difficult matter to make such progress with Safety First in a plant which has neglected to provide one of the fundamental requirements of accident prevention—good lighting.

Probably no one single factor connected with the equipment of a plant so directly affects the efficiency and inefficiency as the quality and quantity of the lighting. The curtailment of production of all working under the disadvantage of poor lighting represents a big loss each day; the poorer the lighting the less able is the working force to function efficiently. Quality and quantity both suffer, representing a preventable loss wholly removable by improving the lighting.

Under poor lighting condition, we cannot expect and rarely do we find an orderly, clean factory. Darkened places encourage careless habits and workers are often led to deposit discarded articles or material which should be deposited elsewhere. The eyesight of those who attempt to use their eyes continually in insufficient light, below nature's demands, is often affected. Too much light, such as is furnished by bright, unprotected lights, is as harmful as too little illumination; both are fundamentally wrong. Nature's own illuminant, daylight, is unequalled for our requirements of lighting.

The eye is best suited to daylight in the proper quantity. Sun glare should be avoided, and in the darkened hours proper artificial illumination provided. Daylight should be utilized to the fullest extent. It is supplied free in abundant quantity for our use. Modern invention has supplied a means whereby the interior of buildings can be lighted by daylight, and all the advantages secured which is furnished by good lighting at the smallest cost.

Industrial buildings should have as much wall space as possible devoted to windows fitted with Factrolite Glass, which insures the maximum amount of daylight and which prevents the direct rays of the sun from passing through as it properly diffuses the light.

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Manager

Before each pile is wedged-up, the load which it is sustaining is measured by a hydraulic gage attached to the ram, and at any time prior to the completion of the work and the filling-in of the working chamber, a pile may be re-tested to ascertain the exact load being carried by it. The foundation engineer is thus able to know very accurately, and by direct observation rather than by any assumption of values, the total carrying capacity of his foundation at any stage of progress, as well as the distribution, column by column.

The depth to which these Pretest piles penetrate the ground is difficult to forecast, depending upon the conditions governing each job,—the test load required, the diameter of the pile chosen, and the softness of the ground; for they are driven, not to any predetermined depth, but to “refusal” under specified conditions of loading. However, when bedrock is more than about 25 feet below cellar bottom, they will undoubtedly affect a saving over any attempt to reach rock bottom. Two economic considerations will encourage this type of construction. Firstly, small cost as compared with piles driven to bedrock, or caissons sunk to bedrock, which will be the usual alternatives in the mind of an architect. Secondly, the saving in time to an owner of at least 80 per cent of the usual number of weeks required by a foundation contractor to do his work, because the foundations and the superstructure are installed simultaneously under this new system. Comparison with foundations of timber or pre-moulded piles will show cost data not adverse to the Pretest foundation, and conditions of stability and freedom from subsequent settlement very markedly in favor

of it. Certainly this development must be interesting to an engineer if only by reason of the audacity of its conception, and the abandonment of much precedent. This, however, has been justified, and four large office structures in New York, one of them 22 stories in height, testify that these theories, worked out by Messrs. Spencer, White and Prentiss, have been put into practice with conspicuous success.

STRENGTH OF CEMENT-SAND-LIME MORTARS

(Continued from page 126)

The first conclusion is not new and only repeats what has been stated many times in engineering literature, i. e., the addition of small percentages of hydrated lime to lean mixture increases the density and strength. It would seem, however, that this addition is not justified in mixtures richer than 1 to 4 by weight, or where the fine aggregate already has an excess of fines present.

Whether or not the characteristics of the mortar indicate the same characteristics in concrete is an open question. Abrams has made the statement¹ based upon many thousands of tests in the Lewis Institute, Chicago, that the strength characteristic of the concrete is very closely indicated by the compressive tests of the fine aggregate and cement as a mortar. It should be stated that the same authority has recently stated² that cement-lime-sand mortars are an exception and give an increase in strength of mortar while concrete shows a decrease with additions of hydrated lime.

Investigations³ of Prof. Macgregor of Columbia show that while the strength of mortar as such is

(Continued on page 141)

On Friday evening, April 1, the annual **The Junior Smoker** presented this year by the class of 1922 was held in Bailey Hall. The occasion was a huge success, the undergraduate body, the faculty and the coaches turning out almost in totum to honor the University's letter men. Bailey Hall was filled to capacity, every seat being taken, thus forcing the late-comers to sit in aisles, or to stand in the corridor. No Junior Class has ever staged a more successful smoker than the Class of 1922.

This year for the first time in history of the Junior Smoker as a Cornell institution the Master of Ceremonies was a member of the Junior Class, Burke Patterson, C. E. '22, having that honor. His witty introductions were not the least entertaining speeches of the evening. "Gil" Dobie started the speaking program with a clear-cut explanation of the causes of the failure of football at Cornell. Mr. Dobie spoke facts which were unpleasant to hear but which were nevertheless very true. He has made a very careful analysis of the football situation at Cornell and revealed his findings to a rather surprised audience. The next speaker was Coach Carney who spoke of his hope of turning out winning teams, and of the importance of intercollegiate and interfraternity baseball in training material for the Varsity squad. Jimmie Munns '14 was next introduced by Pat as the brother of Dave Munns, end on the Varsity football team. Jimmie Munns, who was Captain of the Cornell Football Team in 1914, the last time it defeated Penn, laid emphasis on the idea of harmony and co-operation among the coaches. The Cross County team, which, last winter, gave the combined Oxford-Cambridge aggregation such a close race over the Ryehampton course in England next received its share of praise, the speaker this time being J. T. McGovern '00. A fitting climax in the program was the address on Charles E. Courtney given by Professor Bristow Adams. It was a wonderful eulogy, inspiringly delivered. After the address the audience rose for a few moments to pay silent homage to the memory of The Grand Old Man. In addition to the speeches the committee in charge of the event furnished some excellent stunts and musical novelties. The final number on the program took place when Colonel F. A. Barton presented a "C" to every man who won one during the past year in any of our athletic activities.

Faculty Notes. Cornell was ably represented at the A. R. E. A. meeting held last month in Chicago by two of the faculty, "Johnny" Perry, who took care of the Railroads end of the meeting and "Deacon" Burrows, who represented the Bridges Department. The men left Monday noon and returned Friday

night their classes being taken over by other members of their respective departments while they were gone.

New Baseball Field. Cornell undergraduates and Alumni have been talking of a baseball field on the Campus for years but nothing definite has been done about the matter until this year. A fire last spring destroyed the main stands on Percy Field and the athletic managers were faced with the alternative of making expensive permanent repairs and improvements or starting work on a new baseball field located on the Campus. The second alternative was chosen and last spring work was started on the draining and grading of Bacon Field which is adjacent to Bacon Practice Hall and just south of the New Drill Hall.

Even though considerable progress has been made in preparing the new baseball field it will not be ready for use next spring. The work of draining and grading has been nearly completed at the present time. It would have been finished several months ago but for the nature of the hard, clayey sub-soil which necessitated artificial draining between the rows of tile. The work recently has consisted of leveling the surface with cinders and adding a top dressing of fine soil as a foundation for the turf. The completion of this field will see all the future athletic contests played on what is fast becoming the athletic center of the Campus—Schoellkopf Field, Alumni Field and Bacon Field.

STRENGTH OF CEMENT-SAND-LIME-MORTARS

(Continued from page VIII)

decreased by addition of hydrated lime yet brick masonry laid in cement mortar with small percentages of hydrated lime additives gives a decided increase in strength. Bureau of Standards Investigations⁴ of the strength of Brick Masonry are more or less corroborative of this result. This is said to be caused by the increased moisture bearing ability and increased workability of the cement-lime-sand mortars. In as much as "workability" depends upon the character and grading of the aggregate as well as upon the amount of mixing water, it would seem that in the case of a decidedly coarse or harsh aggregate or in the case of a lean mix the addition of a plastic material like lime would increase the "workability." It is very doubtful if this could apply to finer sands or to rich mixes.

1. Proceedings of Amer. Soc. for Testing Materials, 1918, Part II, page 318.

2. Proceedings of Amer. Soc. for Testing Materials, 1920, Part II, page 149.

3. Bulletin "J" of the National Lime Manufacturers' Association.

4. Bulletin 111, U. S. Bureau of Standards.

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No. 8

EDITORIALS

The Technical Library.

In another month the end of the term will be upon us once more, and the second-hand merchants will be running after those of us who are short of the "root of all evil" with importunate demands to buy our cast-off pants, and our more or less used text-books. If we take the advice of those who are older and more skilled in the ways of the world than we are, we will sell our extra pants, if need be, but unless it is absolutely necessary we will not under any consideration part with our text-books. In after years some treatise on Bridges or on Water Supply which we know we will not use next year, and which we are tempted to sell, may prove to contain information which will be invaluable.

Some time ago we had a letter from a Cornell C. E. graduate in which he deplored the fact that he had taken several courses which were conducted on the lecture system entirely. His complaint was not that he had taken these courses, but that he had no text books which were the foundations of the courses, to which he could refer at any time in his library, so that he could review that part of the work in question whenever it came up in his practice.

Of course, some will say—"That book will be old by the time I will want to use it. Methods will have been improved or changed, and I will then have neither a useful book, nor the second-hand value of the book." But the fundamentals of a subject never grow old, and the really important part of any subject is the fundamental part. Advancements in the way of design may have been made, but these are relatively few and far between and can easily be checked up in any technical periodical. The foundation of a practical design is sound fundamentals. To check up on these most quickly and most safely one must use a text book with which he is more or less familiar rather than one with which he is not even on speaking terms.

To use a text book from which you have studied, be it even but slightly, is not only advisable but, with most work, is nearly indispensable. In most

books at the present time no uniform system of lettering is used in designating the symbols of those equations which so often are nothing more than a series of meaningless letters to the tyro, and at best a complicated mess to the expert. Just for example,—we know of three different text books in Hydraulics which denote the hydraulic radius by three different symbols. Now the expert would in all probability recognize the formulae were they written with English symbols, Pittman Shortland, or Egyptian hieroglyphics. The expert is not the one who would need the text books containing these formulae. It is you, in the years just following your exit from college, who, if you are following the Profession, will need the formulae and who must needs look them up. Would you not rather look in something in which you will recognize the symbols after you find them than to find something which might just as well be Assyrian cuneiform inscriptions, until, somewhere else in the book, perhaps scattered through all that has gone before you find the meaning of the symbols?

Many of our readers must be familiar with the continual wail of anguish on the part of some engineers concerning the faults and deficiencies of the greatest of professions,—the Engineering Profession. Why is it that many engineers will advise a prospective student to study anything but engineering? Surely, there must be some explanation forthcoming from these engineers themselves. We can think of several causes which might be responsible for these conditions, but none seems more important to us than education—or the lack of it—of an engineer after graduation.

It is our belief that more engineers are unsuccessful through failure to improve themselves through study after graduation than from any other one single cause. And it is very peculiar that the engineer should be the one to fall down most from this cause. From the very nature of their professions the lawyer and the doctor, who are often pointed out as models to the engineer, must study and improve themselves after the completion of their college courses. They graduate with the full realization

that they have still much to learn about their chosen professions—the lawyer, because new cases are always coming up just a trifle different from the ones he studied at college, new laws are being enacted, new precedents being established and old court decisions being reversed;—the doctor, because medicine as a science is still very young and only in its first development stage. The engineer stands alone in his class when he believes that he knows all the theory that there is to know just because his college handed him a sheepskin with C. E. engraved thereon upon his graduation. He is alone also in believing that a few months of practical field work after graduation will provide him with all the necessary attributes requisite to success in the engineering field. The lawyer and the doctor buy books after graduation, subscribe to the leading publications in their profession and start a library. The number of doctors and lawyers in this country without private libraries, either in their homes or offices is indeed exceedingly small. But the number of engineers who go through life with enough books as their “library” to fit in their suitcases and still leave enough room for their clothes is, we venture to say, appallingly large. But, even more important than the mere purchasing of the books and the acquisition of an individual library is the using of the library and the studying from the books. If one, whether he be engineer, lawyer or doctor, is to succeed and to achieve fame in his profession he must supplement his college training with study after graduation. One of the greatest incentives toward this study after graduation lies in acquiring, enlarging and improving an individual library.

The engineering profession should learn a lesson from the professions of law and medicine in this respect. The engineer should start acquiring a technical library in his college days. The greatest enemy to the formation of an individual technical library is the prevalent practice of the average American student of selling, losing or burning his textbooks as soon as he has passed the courses which they cover. In later life, the engineer, finding himself without a nucleus around which to build up a library, often neglects to build one at all. The few dozen textbooks which he used at college and which would form an excellent nucleus, are gone—sold for half their price, or carelessly lost, or burned according to some narrow-minded college tradition. Read—do more than read—ponder, study and abide by what Mr. John L. Harrington, one of the foremost bridge engineers in America today said in his address, “The Necessity for Individual Engineering Libraries and for Continuing Study after Graduation,” before the students of the University of Missouri and the University of Kansas in 1908:

“Many a student, instead of taking pride in the growing row of books on his shelf, sells even his

text books as soon as he has received his credits in the subjects of which they treat. He burns his bridges behind him and makes certain that whatever he has not learned from his books will remain unknown, whatever was not clear will remain obscure, whatever he forgets will remain forgotten. When, in his later work, before or after graduation, his memory needs refreshing or a point puzzles him, he cannot turn to the familiar pages and satisfy his needs. No other books will ever supply the desired information so readily as those he pored over in school. Even if the student has not the means or the foresight to begin his professional library by purchasing additional books, the required text books, if retained, form a valuable working nucleus. When the course is completed the days of the text book’s usefulness instead of being over are only begun; and the man who sells his books as soon as he can is already on the high road to failure.”

In concluding our work for the year **Elections** 1920-1921, the Board begs the indulgence of our readers for a short space while we “pat ourselves on the back.” This year started off as what promised to be one of the dull-est in the history of the CIVIL ENGINEER. To encourage us along, we received notice last June that the cost of publication would be double. Then a good many advertisers informed us that their appropriations had been cut down to such an extent that it would be impossible for them to continue to take space in our magazine. On the face of it, the outlook was discouraging enough to make older and more experienced mortals than we give up in disgust. However, in a long and deliberate pow-wow with our advisers, it was decided that with the cost doubled and one source of income somewhat depleted, it would be necessary to strengthen considerably the support from our financial backers, the Alumni. And we are proud to boast that this was the most effective remedy that could have been found, for in the face of all the difficulties, with the help of our Alumni, we have succeeded in bridging this critical period of depression and in coming out ahead on the deal.

Some of you, who have helped us during the past year in the way of articles, advertisements, and subscriptions have received our expressions of thanks personally as far as possible. We ask all of you who have aided us in any way to consider this as the best means at our disposal for showing our gratitude. We can only hope that you will continue to treat our successors as well as you have us. Those of you, who, for some reason or other, have failed to support the CIVIL ENGINEER, we hope will be able to realize the valuable service the magazine is doing for you year after year. We feel sure that the following will be able to serve all of you with the utmost satisfaction for one year beginning with the June issue: C. E. Bryant, Jr., of Mt. Vernon, N. Y., Editor-in-chief; D. L. Copeland of West Bridgewater, Mass., Managing Editor; Miss F. M. Delaney of Watervliet, N. Y., Alumni Editor; H. E. Whitney of Albany, N. Y., Business Manager; G. R. Shanklin of Ensenada, P. R., Circulation Manager; and E. P. McKee of Scranton, Pa., Sales Manager.

LATERAL AND VERTICAL PRESSURE EFFECT OF PILES IN CLAY

An Extensive Series of Tests Demonstrates Effects of Various Methods of Grouping on Resistance of Piles—X-Ray Pictures Determine Displacement of Clay by a Driven Pile

By LT-COL. HENRY R. LORDLY, M.C.E., (Cornell), F.S.E.
Consulting Engineer, Montreal, P. Q.

This paper was presented before the Society of Engineers, London, Eng., and is reprinted for the first time in the United States by permission of the Society.

The above title has been selected under which to describe some results of tests with piles in clay carried out by the author at Cornell University, Ithaca, N. Y., as fellow in civil engineering. The entire series of experiments included similar tests to those made by Alfred S. E. Ackermann, B.Sc. (Engineering), M.Cons.E., the results of which were published in the Journal of the Society of Engineers in March, 1919.

The experiments described herein were carried out on an extensive scale with a specially devised testing plant. The clay was contained in bins holding from two to four cubic yards, the bins being in a basement room unaffected by quick changes of temperature, and the entire series of experiments was completed under the most favorable conditions.

The testing apparatus, carried over each bin on a

special traveller, could be moved in any direction, or taken from one bin to another, as may be seen in Fig. 1. Dead weight loads were used in preference to impact loads, as the former could be more easily applied, and this system also permitted direct comparisons to be made with the results obtained by previous experimenters on somewhat similar lines.

The loads were placed over the pile on a disc which rested on top of the pile. To this disc was connected a rod, $4\frac{1}{2}$ feet long, working in holes bored in the two projecting arms from the registering device which carried the paper on which different penetrations were recorded. On the upper end of this rod was fitted a spring pencil which rotated right and left. After each load was placed and the pile penetrated the clay, the operator recorded the depth of penetration by moving the pencil across the paper and at the same time pushing the pencil against the spring to make contact. The penetra-

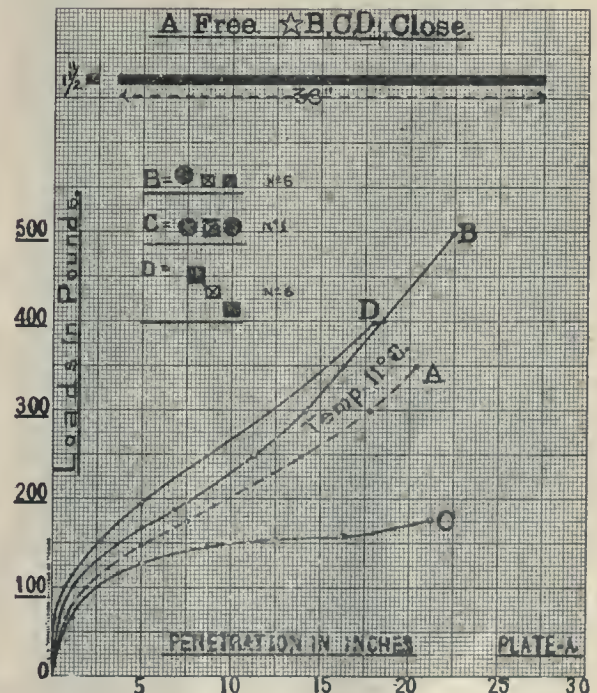
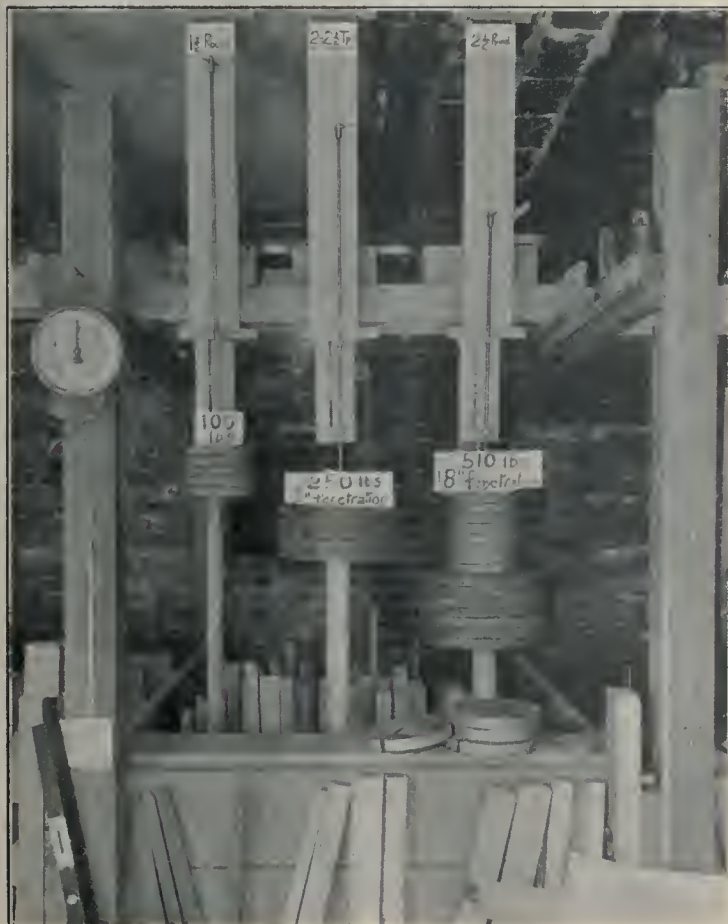


Fig. 1.—(left) An illustration of the special testing apparatus used in Col. Lordly's Pile tests.

Fig. 2.—(above) Square pile C driven between two round piles has less resistance than a "free pile" A. B between a square and a round pile, and D between two square piles, diagonally, have greater resistance than a free pile.

tions, marked from a zero point, were afterwards measured and written on the diagram sheet which was kept as the original notes of the tests.

Piles and Loads

The piles for the entire series of tests were from $\frac{3}{4}$ in. diameter to $2\frac{1}{2}$ in. diameter, but in the tests for displacement, to be described hereafter, the sizes were from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches in diameter. The loads were applied in increments of 20 and 50 pounds, and the maximum total load, in any one test, was about one-third of an English ton. For the larger sized piles, as stated above, the load to cause a penetration of 20 inches was about 500 pounds. The total penetration was up to 30 inches on a pile three feet long, which was the length of all the piles.

The Test Clay

The clay was carefully prepared and before being mixed with water was crushed and sifted and any foreign matter removed. It was sifted first through quarter inch riddles and finally through a sieve having 144 meshes to the square inch. The clay in the fine sifted condition weighed about 82 pounds, and sufficient water was added to give it a water content of about 20 per cent., six per cent. being already in the clay.

A cubic foot of the clay with its water content as used in the tests weighed about 110 pounds.

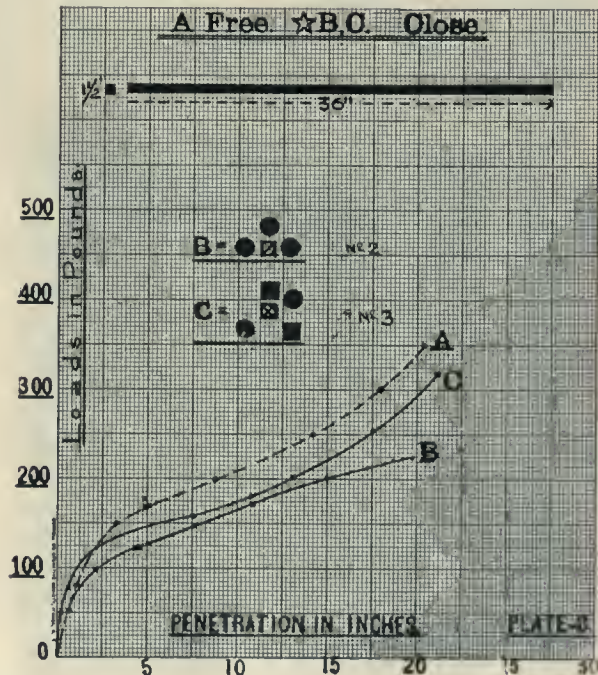


Fig. 3.—A square pile C between two round, diagonally a square pile on north side and a square pile on lower right side, has less resistance than the free pile. Pile B, square between two round and opposite a third round, has still less resistance than the free pile.

The average temperature of the clay, maintained during the tests, was about ten degrees Centigrade. The temperature of the room varied but little, not over seven degrees C. from the coldest day in winter to a hot day in June.

Results of Experiments

The experiments, in the main, have given similar results to those arrived at by Mr. Ackermann, but a more extensive series of tests was arranged and a

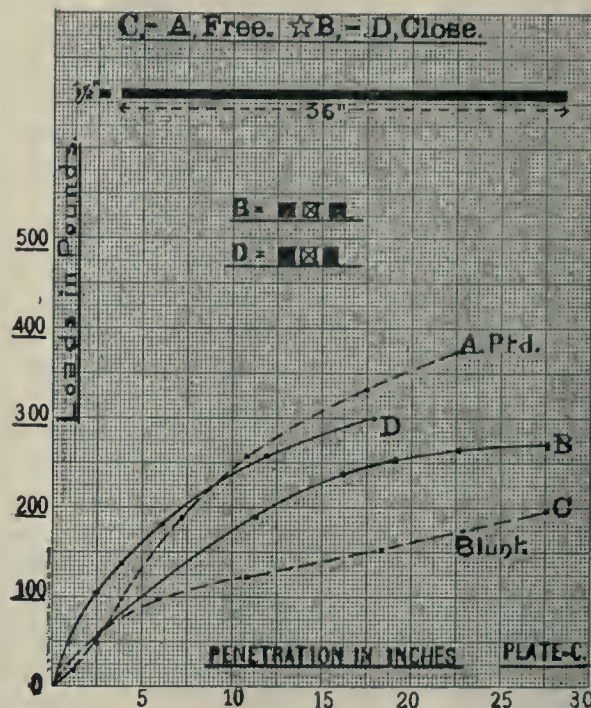


Fig. 4.—B and D, square, driven close between two square piles, show less resistance, lower down, than the pointed pile, but greater resistance than the free blunt pile C.

study of the practical application of all the results has been attempted and will be published later.

The special tests covered by the title of this paper include tests on the grouping of piles to ascertain the minimum distance apart which they can, or must, be placed in clay in order to give the most effective results.

These tests were conducted on practical lines, the loads required to perform the driving of the various piles being compared, and the effect of the distance apart noted. It was thought that some further tests, beyond the driving of the piles, was needed, and as a result of this conclusion a series of experiments which might be called "ocular demonstrations," to show the effect of piles in displacing clay, were carried out. These tests will be described later.

Group Tests

In order to determine the effect on the resistance of piles in various groups at various distances apart, a series of group tests was arranged. The difference of the resistance of each pile in a group was compared to the first pile driven. This pile was always placed more than two or three diameters from any other pile and was designated "a free pile." The piles in the groups were either one diameter apart, or slightly more or less than this distance, and the results were compared with the resistance of the "free pile" of a group; also with piles that varied

slightly from being one diameter apart in other groups.

A study of the curves in Fig. 2, 3, 4, 5, 6 and 7 and the diagram of the spacing of the piles (Fig. 8), together with the tabulated results, will show that piles driven at a less distance apart than one diameter show a varying resistance. This resistance, in a clay soil, is generally greater than the resistance offered by a "free pile," under similar conditions.

The curves on Fig. 4 show that a pointed pile A, free, has a greater resistance than D, a close pile be-

Piles having a less resistance than a free driven pile.

- (1) 1 sq. pile driven between 2 r'nd piles. 1 diam. or less apart.
- (2) 1 sq. pile driven between 3 r'nd piles, 2/3 diam. or less apart.
- (3) 1 sq. pile driven between 2 sq. & 2 r'nd piles. 1 diam. or less apart.
- (4) 1 sq. pile driven between 2 square piles. 2/3 diam. or less apart.

At lowest depth.

Piles having a greater resistance than a free driven pile.

- (5) 1 sq. pile between 1 sq. 1 round. Less than 1 diam. apart.
- (6) 1 sq. pile between 2 sq. diagonally, edges almost touching.
- (7) 1 sq. pile between 2 sq. greater than blunt pile only.
- (8) 1 sq. pile between 2 sq. greater than ptd. pile (low).
- (9) 1 sq. pile between 2 sq. close driven, almost touching.
- (10) 1 sq. pile between 2 sq. one diameter apart.
- (11) 1 round pile between 2 round, close driven.
- (12) 1 sq. pile between 2 square, close driven.
- (13) 1 round pile between 2 round, close driven.
- (14) 1 round pile between 2 round, one diameter apart.

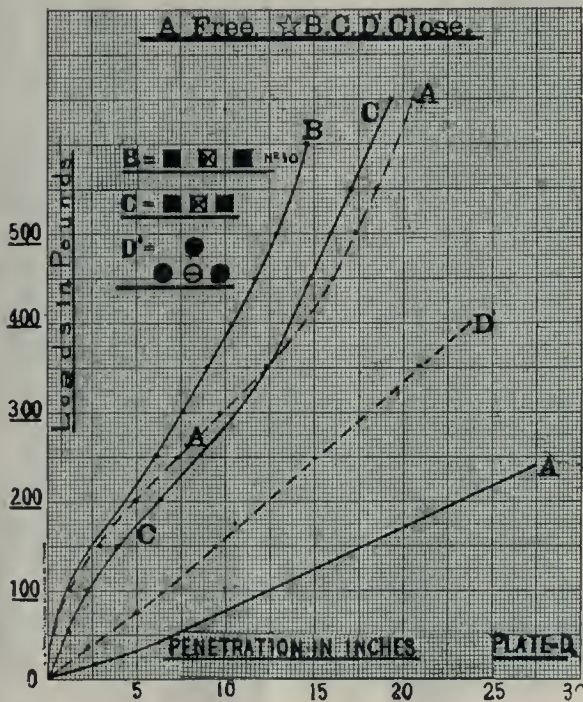


Fig. 5—B and C, one and a half to two inch pile, square, close-driven between two of same size, shows about equal or less resistance than A for the first half-depth, but greater resistance for the lower depth. Note that this pile is tapered. B driven between two similar piles, one diameter distant, has greater resistance all through its descent. Probably in C, the first case, the taper has closed in at the top to such an extent as to cause greater resistance at that point. In the lower curves, A and D, the latter is in the middle of three round piles and opposite a fourth, the resistance is much greater than the "free pile."

tween two others, at its lowest depth. C, a blunt pile, shows less resistance than B, a pile driven close between two piles of like size and shape. It should be noted that all of these piles are square. In order to classify the results, whether the resistance is greater or less when a pile is driven between two others, the following analysis has been made:—

Group Test Results

A summary of the former tests of piles driven close to or between other piles, the results being compared to the load required to drive a free pile, under similar conditions, gives the following results:

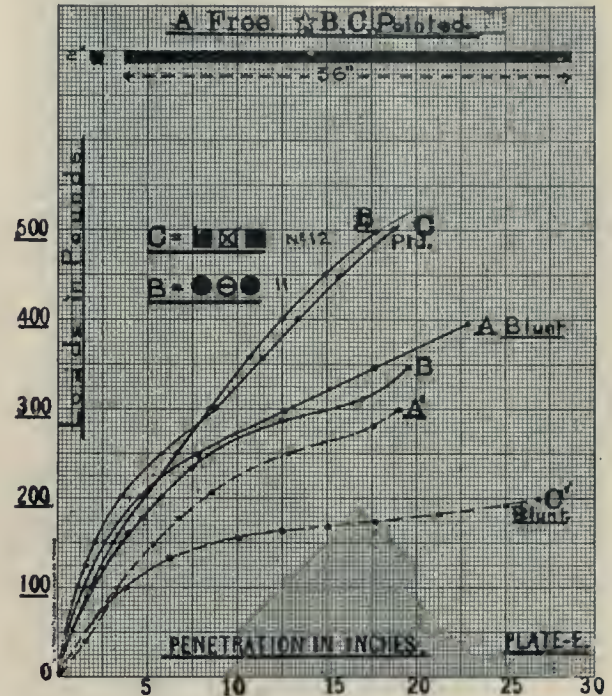


Fig. 6—Shows two sets of curves for two inch piles. C is driven close between two similar piles, pointed, and shows greater resistance over the pointed free pile for the first quarter distance of penetration. Lower down the curves almost touch. It has much greater resistance all through than the free blunt pile. The lower set is for a round pile between two similar piles and almost touching. This shows greater resistance than a similar pile with blunt end, but no so great a difference over a free pointed pile, the curve of which has been left out.

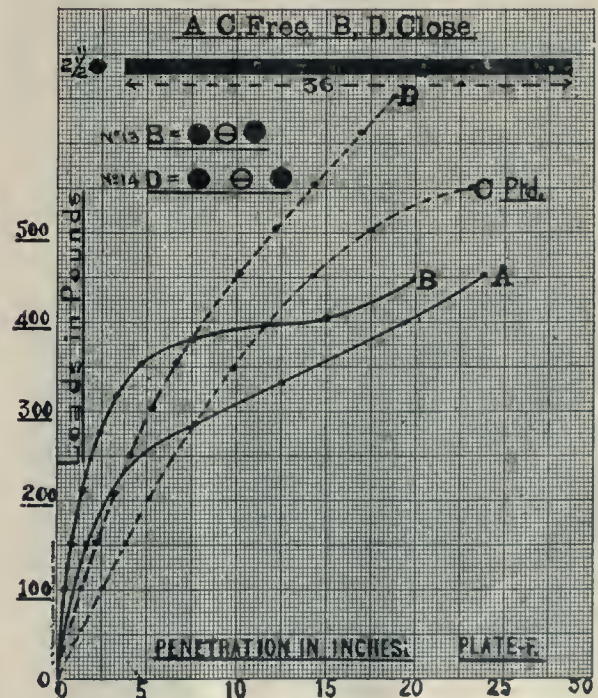


Fig. 7—Shows two, two and a half inch round piles, driven between two piles of same size. B is close driven and D slightly less than the diameter distance from those on each side. B shows greater resistance for quarter of the depth only. D has greater resistance except for the first two inches. C is a pointed pile.

Of the fourteen special tests, four only have a lesser resistance than the "free pile." Two of these are less than one diameter apart. All are square, and three are driven between round piles. Two are in the middle of groups.

Ten of the fourteen test piles, driven between other piles, show a greater resistance than the free piles. Seven are square piles driven between square piles. Three are round piles driven between round piles. In all cases except one the distance from the other piles was less than one diameter.

The safest conclusion to arrive at from the above results is that piles driven in a plastic clay, or sand, between other piles at a less distance than one diameter between their outer sides and the inner sides of the adjacent piles, have a greater resistance than the same piles driven free and unobstructed. The exceptions to this would probably be cases where square and round piles of various sizes are intermingled, although, without further tests, this is

remain unstressed, as a reserve power, the load being equally distributed on the basis that all are free piles, and thus provide an extra resistance as a safety factor in case of overloading at any time. There are many cases where such reserve bearing power would be an advantage.

The above case supposes that all of the piles have an undoubted bearing capacity and that sufficient data are in hand to guarantee that important point. In the case of concrete piles, however, it must be understood that at times there is an element of doubt respecting at least a few of the piles that have been driven, and in this connection the following remarks made by H. E. Sawtell, (Boston Soc. C.E., Journal, Vol. 4, No. 9) are worthy of note. Mr. Sawtell said, "It seems reasonable to assume that the greater part of all concrete piles used are uninjured and doing the work imposed upon them. . . .

"It can also be assumed that most groups of any

Plate 2.

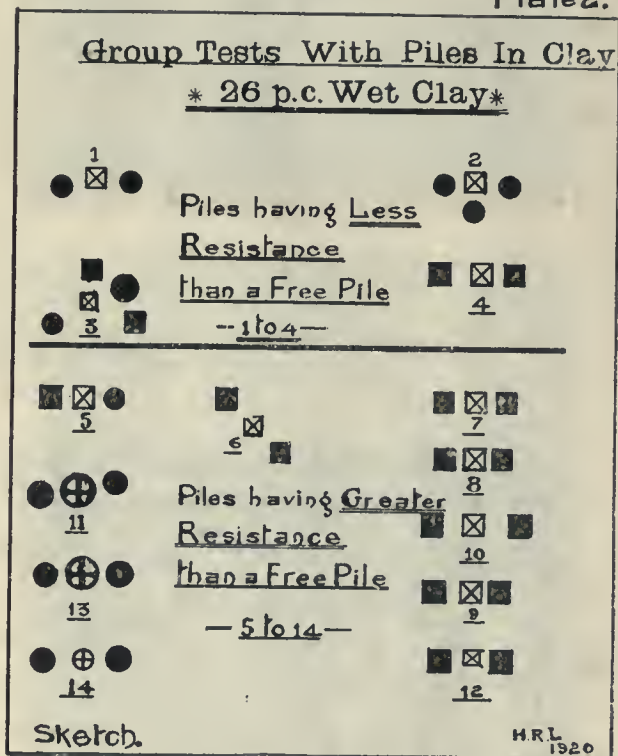
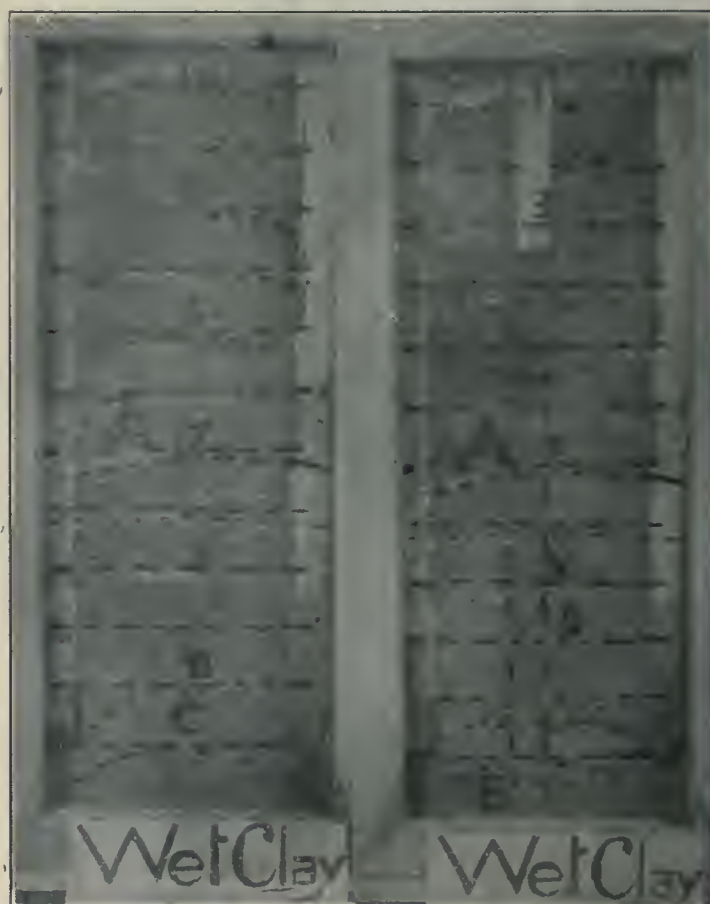


Fig. 8—(above) Spacing diagram. Fig. 9—(right) Displacement of wet clay produced by driving of a pile.



questionable. It must be remembered that if the grouped piles require a heavier driving load they should also carry a heavier dead load than the free piles. This raises an interesting question. Take a case of placing, say, twelve piles in clay over a certain area. Which is preferable, four groups of three closely driven piles, or the twelve piles distributed as free piles over the whole area? If the practical aspect of the construction of the top grillage is the same, and the loading can be properly distributed, the author would prefer the four groups of three piles. The extra resistance of the middle pile can

kind of piles contain some which are not good and which do not perform their part of the work; and yet how many designs include extra piles to make up for this condition?

"It is seldom done, owing to the expense of added piles and to the uncertainty of the number which may be bad.

"In order that the number of bad piles may be reduced to a minimum, it would seem necessary to gain a thorough knowledge of the soil by means of borings rather than to trust to test piles to select



Fig. 10—(left) Displacement of test pile in clay. Fig. 11—(above) This with Figs. 12 and 13 are reproductions of X-ray photographs taken during the driving of piles through clay.

Core Borings Preferable to Ordinary Drilling

The author would make the following comments on the above remarks. He believes that while borings are absolutely essential, it frequently happens that the material is taken out in such a condition as to be somewhat misleading. For this reason core borings, which actually show the composition of the material, are preferable to ordinary drilling, which practically brings up only powdered material.

The question of failing to add extra piles on account of expense is not always a wise policy. The foundation is usually the most important part of any structure, and there is ample evidence to show, all over the world, that the saving of a few dollars at the beginning has caused the loss of many times that amount in the end.

Instead of "spreading all loads over large areas," the author would prefer to group the piles if tests gave similar results to those obtained in the experiments described above.

PART 2

Ocular Demonstration of the Action of a Pile in Clay

On the completion of the above pile tests the author undertook a series of experiments to attempt



Fig. 12—An X-ray photograph of the same test as shown in Fig. 11 at a later stage.

"If properly selected and driven, there seems to be every reason to expect as small, if not a smaller percentage, of poor wood piles than poor concrete piles.

"For medium clays, which are found in a great many places in New England, we have found that the best guarantee against troublesome settlements is a deep embedment of the pile."



Fig. 13—Action of piles in dry material shown by the X-ray.

to show the actual displacement of the clay caused by a pile driven into it.

In the first of these tests a box having a plate glass front was used. A number of horizontal lines, indicated by white sand, were arranged in the clay against the glass front, and as the piles were driven down, the displacement of these lines was clearly seen and the results photographed. An extensive series of tests was carried out, but only a few selected photos will be shown here as the results were similar in all cases, and prove that the side displacement is at least "one diameter of the pile," as previously stated.

One photograph (which is not reproduced) shows the lines caused by a pile driven in dry sifted clay, quite dense material, another showing the result after the pile has been withdrawn, the lateral displacement being more than one diameter of the pile. Fig. 9 is a similar pile driven into wet clay. In this case a pointed pile was driven on the right side of the box and a blunt pile on the left side. The dotted horizontal lines were painted on the glass, for the purpose of reference, in comparison with the curved lines below which represent the displacement caused to the white sand lines in the clay. The latter being wet did not show well. The final position of the lines at position 11, and C, should be noted.

In the photo on the right of Fig. 9, D, shows the effect after a third pile had been driven. This pile was placed in the middle of the space between the other two, and its lines of displacement may be seen by the position of the dotted lines at positions 1, 3, 7, and 9, also at letter E at the bottom. This pile from the figure 7 down was almost one diameter back from the face of the glass, and on this account the curves are instructive.

On comparing the dry with the wet curves it will be found that the former are somewhat sharper at the top, and with the exception of the very bottom curves are quite similar.

Various sized piles were similarly tried, and in all cases the side effect was always, at least, one diameter of the pile.

Fig. 10 shows a photo of the largest test made, viz., a $5\frac{1}{2}$ inch pile. The material here was dry at the top and wet at the bottom, and the test was made after the clay had stood for some days. The pile could not be driven by ordinary pressure, to a greater depth. The lines were made clear by placing iron filings between white sand in the upper layer, which was perfectly horizontal at the beginning. As in the former cases the lateral effect is at least one diameter. The vertical effect may be influenced by the shallowness of the box.

After analyzing the various tests with the glass front box, the question arose whether the clay being against the glass was not influenced by the latter, and, also, what distance back was the clay dis-

placed by the action of the pile? A solution of this problem was suggested by Dr. J. S. Shearer, Ph.D., the specialist in charge of the X-ray branch of the Department of Physics of Cornell University, and a series of experiments for the author was carried out by Dr. Shearer. The results of these tests are now published for the first time.

X-Ray Tests of the Action of a Pile in Clay

Beyond stating that the X-Ray apparatus at Cornell University is believed to be about the most efficient in existence, no description of it will be undertaken here. The clay was contained in a box having a thickness considerably more than the diameter of the pile, and of sufficient breadth and height to permit of a natural movement of the clay body as the pile was driven down. Tests were made both with dry and wet sands and wet clay. The horizontal lines were represented by fine iron filings, and in one test sands of various grades of fineness were used.

Before taking the X-ray picture an examination of the tests, at various stages, was made in front of the fluoroscope apparatus in connection with the X-ray plant. By this means the various stages of displacement could be seen and the action of the pile stopped at any desired depth. The X-ray photos were then taken, the plates developed and the prints made in the usual manner.

Results of X-ray Photographs

Figs. 11 and 12 show different stages of the same test. The two piles on the left are a square pointed pile and a square blunt end pile. They are at the same depth, but the vertical displacement under the blunt pile is seen to extend much lower than the pointed pile. The lateral displacement, however, of the pointed pile extends further than that of the blunt pile.

The two piles on the right are round, blunt and pointed, and the vertical effect may be seen to extend to the third line below the blunt pile and slightly into the fourth line. In respect to the lateral displacement, it is interesting to note how the material clings to the side and point of the pile and is apparently carried down by it. The material between the second and third lines is white sand, and a careful study will show how the grains of sand have conformed to the general curvature of the former horizontal lines. The lower portion of the box was filled with plastic clay, cut into blocks, the first row of these blocks below the seventh horizontal line, being spaced and filled in between with sand. The reason for this will be seen in Fig. 12, where the piles have been driven through and into this clay section. The general form of curvature has been continued throughout the various layers of sand, and the amount carried down by each pile end is seen, each layer apparently having contributed its share to the pointed pile. Numbers two,

three and four have pierced the clay, and the distortion of the space between the clay blocks easily shows the extent of the side displacement.

Carefully note this displacement under the second pile, square, from the left. The distortion of lower block three may be seen, the fourth and fifth block remain intact.

Fig. 13, shows layers of sand having various degrees of fineness and two layers of sifted clay. This is a dry test, but the result does not differ much from the same test made with wet materials, the piles having been forced down slowly with a gradual descent. The pile on the left is round with a point having an angle of sixty degrees at the apex. The middle pile is a round pile having a stream line point as shown at page 90 of Mr. Aekermann's paper, Trans. of the Society of Engineers, Vol. X, No. 2, and suggested by Mr. Etchells. It was tested for the purpose of showing what the action of a pile pointed in this manner would be. The lateral displacement is seen to be about the same as with the other piles, and is at least "one diameter," but the small amount of iron filings clinging to the stream line point is certainly astonishing. This pile went down very easily, compared to the other piles, and a study of the sand grains in the lower stratum, near the point of the pile, shows that the side displacement does not extend apparently as far as with the other piles. A lantern slide study, with a strong light, would probably show better. The pile on the extreme right is the most interesting of any of the piles driven. It is a corrugated pile, and it is easily seen that more material, the iron filings, is clinging to its sides than in any of the other cases. This means, of course, greater resistance.* Compare line four from the top and its curvature around the corrugated pile with that of the round stream line pile on the left. The vertical displacement under the blunt pile is also considerably more than under the stream line pile.

It will be noted that the curves here conform to those in the glass front box test and prove that the latter may be accepted as being approximate to the actual conditions.

Final Conclusions

The question naturally arises whether the results herein recorded really exist in large sized piles driven to depths of many times their diameter. We have shown miniature piles and one pile up to five and one-half inches in diameter, although only in a shallow depth of clay. The author has several photos of piles dug out in some of his own work, but unfortunately these were driven in a hard material having no stratifications that would readily photograph, but influence has been observed up to one diameter of the pile. However, on front cover is

shown a photograph taken from the Journal of the Boston Society, C. E., Vol. 4, No. 9, of a pile driven in stratified material. This is a concrete pile, and the foot note under the original photograph says: "Note also the action of the pile on the different strata of the earth, showing that the compression of the earth does not extend but a short distance from the outside surface of the pile."

It would appear, if these curves were formed by the action of the pile, and that is the indication in the upper strata at least, that the influence is considerable and certainly extends at least to "one diameter of the pile," which the author's experiments show it should do.

The deductions that can be reasonably made from the foregoing experiments are that:—

(a) In a clay soil there is a particular distance apart at which piles should be spaced in a group in order to get the best bearing efficiency.

(b) The minimum lateral displacement in a clay soil, or sand, extends to at least one diameter of the pile in all directions.

(c) In grouping piles in a plastic clay, to get the greatest bearing efficiency, the middle part of any group should not be more than one diameter distant from the adjacent piles. Outside measurements, from pile to pile, should be taken. This deduction is based on (b) above.

(d) A group of small, or medium sized piles, in plastic clay, should give greater efficiency than one large pile, or two medium sized piles. As an example to discuss, take three piles of six inch diameter compared to one pile of sixteen inches in diameter.

The author has no comments to make on the above deductions except to state that in considering the last case (d), the ratio of the end bearing to side friction, in each case, must be considered. He has carried out extensive experiments on this important point, which experiments show that the side friction is greater than is generally supposed.

The author gives further details of the experiments as follows:

The clay was the usual brownish yellow clay as found in Ithaca, N. Y., U. S. A., district, and was taken from an excavation for a cellar. Its mechanical analysis by Mr. Vernon Davis, M. A., was:—

| | |
|------------------------|--------|
| Loss on ignition | 9.73% |
| Sand | 1.85% |
| Fine sand | 1.77% |
| Silt | 26.99% |
| Fine Silt | 15.91% |
| Clay | 44.22% |

100.47%

After any load was applied to the pile, the penetration was recorded when the pile had come to

(Continued on page XI)

*This corrugated pile required more force to pull out than either of the other two.

AN INVESTIGATION OF THE ONE-HINGED ARCH AND ITS COMPARISON WITH OTHER TYPES

By NEE SUN KOO, B. S., M. C. E. (1919).
McGraw Fellow in Civil Engineering, 1920-21.

An Abstract of a Thesis to be Presented to the Faculty of the Graduate School of Cornell University for the Degree of Doctor of Philosophy.

(Continued from the April issue)

DISCUSSION ON TRUE DESIGN

So far as the reactions are concerned, the effect of final design as compared with that of the preliminary design, assuming $I \approx \sec.0$, is to increase the horizontal reactions when the load is near the center of the span and to decrease the same when the load is near the ends. There is no appreciable change in the vertical reactions for the two designs. The end moments have been affected so greatly that under the full loading, a negative end moment is produced in this design, which was not the case in the preliminary design. The latter has a serious effect in designing the sections, because the sign of the dead load moment is changed to negative, and the maximum moments at various sections are thereby changed.

The preliminary design by assuming $I \approx \sec.0$ is far from being correct. It makes the flange areas at the various sections far different from the true values. The error is on the unsafe side. It is necessary that a revised design be made in designing a one-hinged arch.

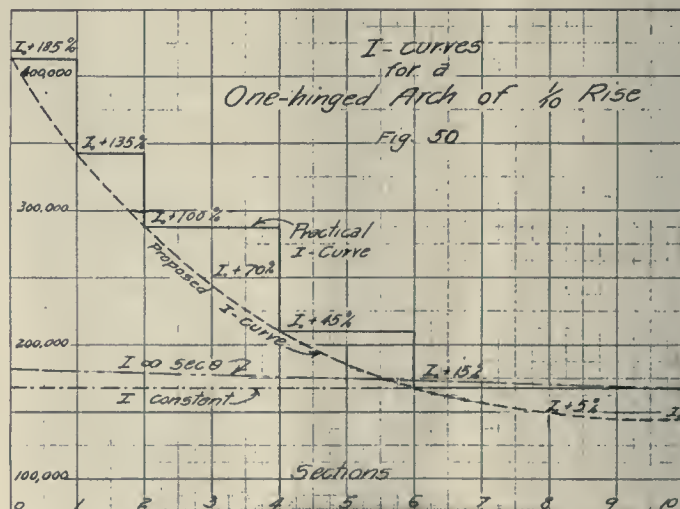
The preliminary design by assuming $I \approx \sec.0$ is nearest to the true value for the two-hinged arch, while it differs most in the one-hinged arch. The relative error of the preliminary design from the true design of the no-, one-, and two-hinged arches with same dimensions and designed to carry the same load is shown below:

| Section | No-hinged per cent | One-hinged per cent | Two-hinged per cent |
|---------|-----------------------|------------------------|------------------------|
| 0 | —15.5 | —30.7 | 5.2 |
| 1 | —13.4 | —31.6 | —3.7 |
| 2 | —7.6 | —33.1 | —4.7 |
| 3 | —2.4 | —34.4 | —2.5 |
| 4 | —3.6 | —40.5 | 2.4 |
| 5 | 8.7 | —33.3 | 3.3 |
| 6 | 5.6 | —27.0 | 7.6 |
| 7 | 4.1 | —21.0 | 12.8 |
| 8 | 3.7 | —16.1 | 12.1 |
| 9 | 2.5 | —12.8 | 11.6 |
| 10 | 2.1 | —11.7 | 13.7 |

Thus, we see that the error in the one-hinged arch is the largest of all. This is due to the presence of the large moments in the sections near the ends and the large thrust in the sections near the crown. The variation of the moments and thrusts in the sections near the crown that the moment of inertia in the various sections required is not in accordance with the relation $I \approx \sec.0$.

As the assumption $I \approx \sec.0$ is far from being true, the I-Curve for a one-hinged arch with 1/10 rise is recommended by the author, by means of which a closer result can be secured in the approximate design. A similar curve was recommended for the no-hinged arch by P. H. Chen in his thesis above named. The comparative values are shown below:

| Section | One-hinged | No-hinged |
|---------|---------------|---------------|
| 0 | $I_0 + 185\%$ | $I_0 + 120\%$ |
| 1 | $I_0 + 135\%$ | $I_0 + 60\%$ |
| 2 | $I_0 + 100\%$ | $I_0 + 30\%$ |
| 3 | $I_0 + 70\%$ | $I_0 + 15\%$ |
| 4 | $I_0 + 45\%$ | I_0 |
| 6 | $I_0 + 15\%$ | $I_0 + 10\%$ |
| 8 | $I_0 + 5\%$ | $I_0 - 10\%$ |
| 10 | I_0 | I_0 |



It is seen from the curves that the assumptions of $I \approx \sec.0$ and $I = \text{constant}$ are nearly correct in the sections near the center, while they are too small in the sections near the ends. The exceedingly large moments near the ends both in the no-hinged and one-hinged arches necessitate the use of the large sections and accordingly the values of the large moments of inertia.

DISCUSSION OF METHODS OF DEFLECTION COMPUTATIONS

Deflections in the one-hinged arch-ribs are contributed by two factors, that due to thrust and that due to moment. The methods used by the author in

finding these deflections are rather interesting and are here given.

(a) DEFLECTION DUE TO MOMENTS—The formulas for finding the horizontal and vertical deflections of a curved beam were given in equations (d) and (e) respectively. As the continuity of the one-hinged arch is broken at the crown by the presence of the hinge, the formulas could not be applied directly to the entire span. A method of separating the arch into two cantilevers is introduced (Fig. 3). For example, when the load is at a certain point on the left half of the span, the reactions acting on the left cantilever are H_1 and V_2 , while those on the right cantilever are H_1 and V_2 . The left cantilever is contributed by three factors, due to P , H_1 and V_2 , while those in the right cantilever are contributed by two factors, H_1 and V_2 . These factors can be easily found by considering each half in turn as a cantilever with one load on the arch. Thus, under the vertical load P on the left cantilever, we only need to find the deflections in the cantilever due to a horizontal load at the free end, a vertical load at the free end, and a vertical applied load. The deflections due to H_1 and V_2 in the left half of the arch are just the same in magnitude as those due to H_1 and V_2 in the right half of the arch. The final value of the vertical or horizontal deflections can be easily obtained by taking the algebraic sum of the vertical or horizontal deflections contributed by the various factors.

If the deflection diagrams are required for a unit load at different positions on the left half of the span, the method is exceedingly simple. We need only to draw the deflection diagrams of the cantilever with a unit horizontal load at the free end, and a unit vertical load at different positions on the cantilever corresponding to the positions on the arch. These are obtained as unit deflections. The values of H_1 and V_2 are then found for different positions of the unit applied load. The deflections due to H_1 and V_2 are then found by multiplying the unit deflections by the values of H_1 and V_2 . Using proper signs of deflections contributed by each factor and taking the algebraic sum, the deflections at various points on the arch can be found for different positions of the loading.

The method has several advantages: first, it is simple as well as easy; second, it offers the opportunity of studying the deflections contributed by each factor; third, it is easy to discover mistakes. By means of the graphical method, the deflection on the cantilever due to a unit vertical or horizontal load at any position on the beam can be easily calculated. By arranging the work in a systematic way, errors can be easily discovered by comparison.

The method is applicable in any of the four cases: (1) vertical deflection under the vertical load, (2) horizontal deflection under the vertical load, (3)

vertical deflection under the horizontal load, (4) horizontal deflection under the horizontal load. The only difference lies in the magnitude and direction of H_1 and V_2 and the unit horizontal or vertical deflections to be found in the cantilevers.

(b) DEFLECTION DUE TO THRUST—The general formula for the deflection due to thrust is given by

$$\text{Deflection} = \int_a^b Tt \frac{ds}{AE}$$

in which T is the thrust due to the applied load P ; while small t is the thrust due to a load unity P'' applied at the point whose deflection is sought, the direction of P'' being the same as the direction of the deflection required. Let H' and V' be the horizontal and vertical shear (not in the normal section) immediately on the left of the section considered; and H'' and V'' , those due to P'' respectively. Then, by substitution, the general formula of deflection due to thrust becomes,

$$\text{Deflection} = \int_a^b H'H'' \cos^2 \theta \frac{ds}{AE} + \int_a^b V'V'' \sin^2 \theta \frac{ds}{AE}$$

which is applicable to the four cases above named, that is, the vertical and horizontal deflections due to the horizontal load.

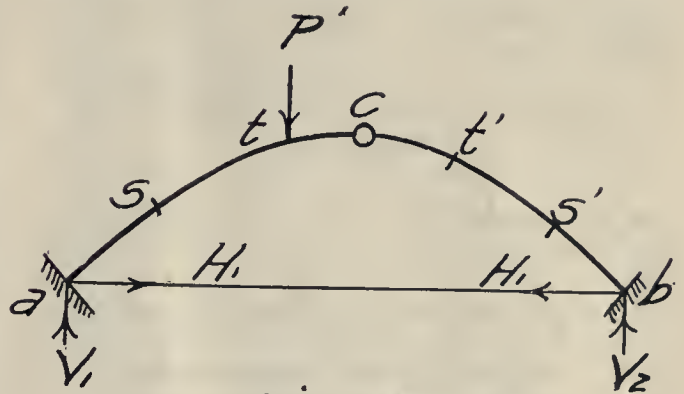


Fig. 59

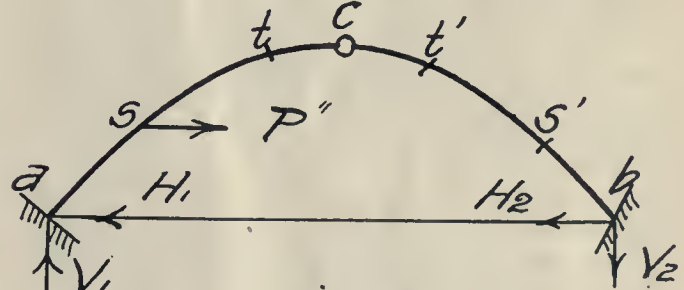


Fig. 60

In order to simplify the numerical work (the above formula may be transformed into a simpler form for each of the different cases. For example, let us take the case of the horizontal deflection under the vertical loading. Let a unit load P' be applied at t and the horizontal deflection at s be found. (Figs. 59 and 60). The corresponding points on the other half of

the arch are called s' and t' . In examining the loading and reactions closely, we find that H' and H'' in s - c and s' - c are correspondingly equal. H' in a - s is also equal to H' in b - s' under the load P' ; while under the load P'' , H' in a - s is equal to H_1 and H' in b - s' is equal to H_2 . Also V'' in t - c and t' - c are correspondingly equal. V'' in a - t is equal to V'' in t' - b , while V'' in a - $t=V_1$ and V'' in b - t is equal to V_2 . Using the proper signs, the formula is given by

$$D = 2 \int_s^c H H'' \cos^2 \theta \frac{ds}{AE} - \int_a^s (H_1'' - H_2'') H' \cos^2 \theta \frac{ds}{AE} + \int_a^t (V_1' - V_2'') V'' \sin^2 \theta \frac{ds}{AE} - 2 \int_t^c V V'' \sin^2 \theta \frac{ds}{AE}$$

It is seen that the terms containing V s can be neglected, because the angle of is not greater than 30 degrees and the squares of sines will be small in value. The net result of the horizontal deflection due to V s is negligible in comparison with the deflections caused by H s in the thrusts and that by the moments. By means of transformations the following formulas are derived with several approximations:

For vertical deflection due to thrust under the vertical load;

$$D = 2 \int_a^c H H'' \cos^2 \theta \frac{ds}{AE}$$

for horizontal deflection due to thrust under the horizontal load;

$$D = 2 \int_s^c H H'' \cos^2 \theta \frac{ds}{AE} - \int_a^s (H_1'' - H_2'') H' \cos^2 \theta \frac{ds}{AE} - \int_a^t H_1'' (H_1' - H')$$

and for vertical deflection due to thrust under the horizontal load;

$$D = 2 \int_t^c H H'' \cos^2 \theta \frac{ds}{AE} - \int_a^t (H_1'' - H_2'') H' \cos^2 \theta \frac{ds}{AE}$$

DISCUSSION ON DEFLECTIONS

The moments and thrusts are equally important in causing the deflections in the one-hinged arch. The latter is especially important in the sections near the center. In considering the deflections caused by the thrust, the vertical forces may be neglected without appreciable error. Shear can be neglected too.

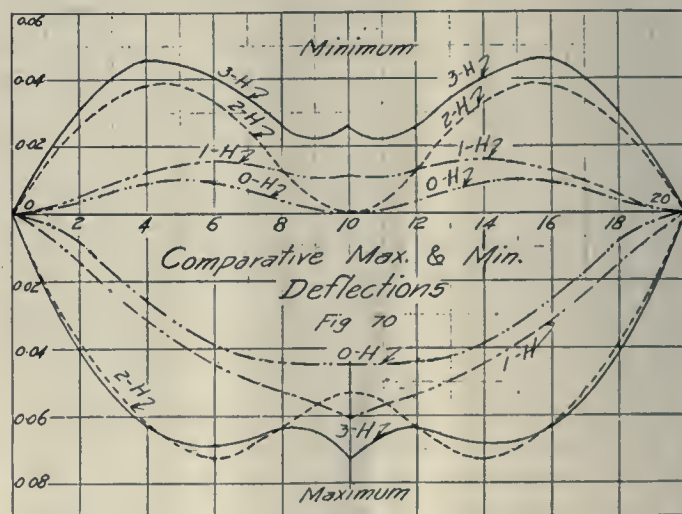
Under the vertical loading the vertical deflections near the end of the arch are similar to those of the no-hinged arch, while those near the center resemble in the form those of the three-hinged arch. As a whole, the one-hinged arch is subject to greater vertical deflection than the no-hinged arch and less vertical deflections than the two-, and three-hinged arches for the vertical loading. Thus, the no-hinged arch is the most favorable in stiffness among the four types of arches, so far as vertical deflections under the vertical load are concerned. The one-hinged arch comes the next, the two-hinged arch comes third, and the three-hinged arch is the most

unfavorable of all. Comparative deflection curves for the four types of arches with the same dimensions and designed under the same loading are prepared by the author for different positions of the loading. They are not here reproduced due to the limit of space.

The same relation is found for the horizontal deflections under the vertical loading for the four types of arches. The horizontal deflections of the three- and two-hinged arches are much greater than those of the no- and one-hinged arches, while the horizontal deflections of the no- and one-hinged arches are about the same. Comparative curves of horizontal deflections under the vertical load for the four types of arches are also prepared by the author.

Under the horizontal loading, the vertical and horizontal deflections for the one-hinged arch are found to be very small. This seems to indicate that the vibrations under the moving train are low, and the effect of wind is also rather unimportant for this type of the arch. Comparative curves of deflections under the horizontal loading for the four types of the arches shows that the one-hinged arch has greater horizontal and vertical deflections than the no-hinged arch, and less vertical and horizontal deflections than the two- and three-hinged arches.

The comparative maximum and minimum deflections for the four types of arches are shown in Fig. 70. The one-hinged arch is again seen to be stiffer than the two- and three-hinged arches, and not so stiff as the no-hinged arch.



The yielding of a support has a serious effect on the stresses. With a horizontal movement of the support of one inch away from the original position, an additional value of 126.8 kips is increased in the horizontal reactions. This increases the thrust at the crown to twice the original value, and thus greatly affects the safety of the arch. The yielding of supports has a similar effect on the two- and no-hinged arches. The effect on the one-hinged arch

(Continued on page IX)

**HARRY N. HOWE, C. E. '04 APPOINTED CITY
COMMISSIONER OF MEMPHIS**



Mr. Harry N. Howe, C. E. '04 has just been appointed Commissioner of Streets, Bridges and Sewers for the City of Memphis, Tenn. This position carries with it a great deal of responsibility, as Memphis has just planned an extensive program of sewer construction, street improvement and extension, and grade separation.

After graduating from Cornell Mr. Howe was connected with the U. S. Engineers' office at Memphis, Tenn., from July, 1904 to March, 1906. From then until the fall of 1907 he was connected with the Turner Construction Company in New York City. In the fall of 1907 he returned to Memphis and became a partner in the firm of Gardner and Howe. Mr. Howe's firm enjoys an enviable reputation in the Central South, having constructed a number of steel and concrete buildings in Memphis and in the states of Tennessee, Mississippi and Arkansas. Mr. Howe enters the office of City Commissioner with a wealth of engineering experience and with an excellent knowledge of the conditions existing in Memphis today.

The appointment of Mr. Howe is not a reward for political service but is an indication of the esteem and respect with which Mr. Howe's ability as an engineer is recognized. In announcing his selection Mayor Paine said, "I know Mr. Howe, and I am impressed with his splendid personal qualities. Under him the Department of Streets, Bridges, and Sewers will be conducted in a manner that will reflect credit upon the city and will give satisfaction to the people of Memphis. In addition

(Continued on page VII)

**EZRA B. WHITMAN, C. E. '01 NOMINATED FOR
TRUSTEE**



Ezra B. Whitman, C. E. '01 has been nominated for the position of Alumni Trustee and the nominations have been closed with three candidates in the order of filing, are Erskine Wilder, '05 of Chicago, Hebert D. Mason, '00 of Tulsa, Oklahoma, and Ezra B. Whitman, '01 of Baltimore.

Whitman was born in Baltimore on February 19, 1880, the son of the late Ezra B. Whitman and Belle Cross (Slingluff) Whitman. He prepared for the University at the Baltimore City College and entered Cornell in the fall of 1897, graduating C. E. in 1901. He won a University Scholarship in his freshman year. He was one of the organizers and the first president of Pyramid, and also president of Rod and Bob. He is a member of Delta Upsilon, and since graduation has been elected to membership in Sigma Xi and Tau Beta Pi. While in the University he was a member of the hockey team and of his class baseball and track teams.

He was married in 1906 to Miss Fanny Glenn, of Brooklyn, and they have a family of two sons and one daughter and reside at 139 W. Lanvale Street, Baltimore, Md.

After he had worked for a year in sanitary engineering in New York and Chicago, the firm of Williams and Whitman was organized with headquarters in New York. Between 1902 and 1906 engineering work was carried out by this firm in New York, Connecticut, Massachusetts, New Jersey, Pennsylvania, Maryland, Tennessee, Ohio, and Texas.

In 1906 he was appointed division engineer of the Baltimore Sewerage Commission, and had charge of the Sewage Experiment Station, the materials test-

(Continued on page VII)

THE CORNELL CIVIL ENGINEER

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COLLEGE NOTES

C. E. Association Meeting

On Friday evening, April 22, the Association of Civil Engineers of Cornell University held one of its most interesting meetings of the year. The first part of the meeting was held over in Sibley Dome, where the members of the Association viewed a three reel moving picture show entitled "The King of the Rails," which depicted the various stages in the advance of transportation for the past three hundred years. Much thanks is due to the General Electric Company who produced the picture and who sent it to the Association free of charge. After the showing of the movie was completed, the members adjourned to the Materials Lab. in Lincoln Hall where a short business meeting was held. Plans and preparations for the nomination and election of next year's officers of the Association and the members of the Honor Committee were made. Professor Conwell strongly urged that every C. E. student who could possibly handle a ball should get out and try for the college team, stating that the C. E. baseball team expects to make a strong bid for the intercollegiate baseball trophy. Plans were made and a committee appointed to supervise the production of a show at the Spring Day Circus. After the transaction of business had been completed, refreshments were served consisting of ice cream, crackers, and cigarettes.

Fuertes Prize Speaking Contest

On Friday evening, April 15, 1921, the annual Fuertes Prize Speaking Contest was held in Room 1, West Sibley. Professor Ogden presided at the contest. The judges were Professor Seofield of the School of Civil Engineering, Professor Diederichs of the School of Mechanical Engineering, Dean F. H. Bos-

worth of the College of Architecture, Mr. R. Hannah of the Department of Public Speaking and Mr. C. F. Wyckoff who was selected by President Smith from the business men of Ithaca.

The undergraduates who participated in the contest and the topics on which they spoke were as follows: A. P. Pigman, M. E. '21, "Another Carnot Cycle;" L. R. Chapman, Arch. '21, "A New University—Its Plan and Design;" W. Pollack, C. E. '21, "Cooperation with Labor;" E. H. Krieg, M. E. '22, "A New Power Plant for Ithaca;" C. M. Stotz Arch. '21, "That an Architect Be Consulted on the New Eddy Street Bridge Design;" and C. F. Ostegren, M. E. '21, "Smoke Prevention at Cornell."

The first prize of \$125.00 was awarded to L. R. Chapman, Arch. '21; second prize of \$35.00 to C. M. Stotz, Arch '21 and the third prize of \$20.00 to C. F. Ostegren, M. E. '21.

More interest is being shown in crew this year than formerly and things look very good for another run of victories both in the Spring Day Races and in the Interecollegiates at Poughkeepsie on the twenty-second of June. Two Varsity and two Freshmen Crews stayed in Ithaca during the spring vacation and were able to row five out of the seven days. The other two days the weather was so bad that it was thought best for them not to attempt to go out. Several of the days on which the crews were out they went on the Lake, and in practice races good time was made considering that it is still the beginning of the season.

After vacation Coach John Hoyle announced that for the present the boat stroked by Wilson will be known as first Varsity and last year's frosh combination which has lost but one man will be second Varsity with Freston's crew as third. This may be only temporary as it is rumored around the hill that

last year's Frosh are coming ahead fast and may hang up a better record than they did last year when they made the best time in the Interecollegiates.

Coach Hoyle has also picked a heavy and light freshman crew between which there is keen rivalry but the 1924 crew will not be picked definitely for some time.

A 150 pound crew, a possible representative in the American Henley, is also practicing daily on the water and, if it shows sufficient speed, Cornell will be represented in that race.

Phi Kappa Phi Elections Among the twenty-one graduate students elected to Phi Kappa Phi, national honorary scholastic society, a chapter of which was established here at Cornell last June, was Prudence Frias Esquivel of the School of Civil Engineering. Phi Kappa Phi is an honorary society on the order of Phi Beta Kappa and Tau Beta Pi, undergraduate honorary societies, differing in that it selects members from all departments in the university.

Lacrosse This spring vacation the Varsity An increasing interest is being shown in lacrosse and a large number of candidates are turning out daily for practice under Coach "Nicky" Bawlf, among whom are several veterans. Last year Cornell finished second in the Northern Intercollegiate Lacrosse League and it is hoped that this year's team will show up even better.

On the southern trip the team broke even, winning two out of four games. On Friday, April 8, the Varsity lost to Penn on Franklin Field by a score of two to one after what proved to be one of the hardest fought contests of the trip. The Cornell twelve got the jump on the Quakers in the first few minutes of play when Captain Taylor scored, but the Penn defense tightened in the second period and the Varsity was unable to break through again. In the second game, the Cornell twelve was outclassed by the strong Navy aggregation and was defeated by a score of 15 to 2. The midshipmen, nine of whom were on the 1920 Navy Football team, set a fast pace and showed clearly that they were superior both in team play and stickwork.

The first victory for Cornell came on Monday, April 11, when the Varsity downed the University of Maryland team by a 2 to 1 score. Malone and Taylor were responsible for the two Cornell goals, both of which were made in the first half. The last game of the trip resulted in a victory over Swarthmore, the game ending with a score of 1 to 0. The game was stubbornly fought and in this game the Red and White made the best showing of the tour. Hermann scored in the first half when, after eluding his guard, he received the ball from Cary and shot it past the Swarthmore goal tender.

The results of the Spring trip show that with a little more experience the Varsity will be able to make a very creditable showing in the league this season. The team played a non-league game with Colgate on April 23 at Ithaca, resulting in a 3 to 3 tie.

The remainder of the schedule as announced by Graduate Manager "Rim" Berry is as follows:

May 14—Yale at New Haven.

May 16—Harvard at Cambridge.

May 24—Hobart at Geneva.

May 28—Syracuse at Ithaca.

Annual C. E. Banquet The annual banquet of the Cornell Association of Civil Engineers was held at the Hotel Ithaca on Saturday evening, May 7. From all reports, it was not only a huge success but also a rip-roaring good time. To say that a "good time was had by all" is begging the question. Everyone present seemed to agree that a wonderful time was had by all.

The banquet started about 6:45 when all sat down to a real "square" meal. A chicken dinner did the trick for those who were in the habit of sustaining themselves on cafeteria hash. The menu was so camouflaged that only those well versed in the terms used in civil engineering could understand what the courses would be. Four inch rivet head signified grapefruit, red bridge paint meant ereme tomato soup, rubber with an elastic limit of infinity was the C. E. term for chicken a la King, neat cement paste signified mashed potatoes, etc. Indeed, those who were blessed with sensitive stomachs were truly "out o' luck" when it came to enjoying the repast to their hearts content. Still no one complained about drinking crude oil, which in lay talk means coffee; and no one, to our knowledge, left the table on account of having to eat vitrified brick, more commonly known as brick ice cream. The chefs at the hotel report that there was a big demand for 1:2:4 mix concrete which is ordinarily known as cake. And everyone agreed that it was pretty rich concrete, too. The feast being over, all sat back and enjoyed their concrete piles and railroad spikes (Murad and Fatima cigarettes) and listened to the most interesting speeches ever delivered at a civil engineer's banquet.

Burke Patterson, C. E. '22, was toastmaster and master of ceremonies all in one. His clever and witty introductions of the speakers were not the least interesting bits on the program. Ira W. McConnell, '97, President of the Cornell Society of Civil Engineers and member of the Board of Direction of the American Society of Civil Engineers, was the main speaker of the evening and gave a very interesting talk which included some very sound advice for young and student engineers. Mr. McConnell's wealth of experience and knowledge of men made his remarks particularly impressive to all budding engineers. Dean D. S. Kimball of the College of Engineering gave his usual interesting talk. Professor F. A. Barnes, Director of the School of Civil Engineering gave a very interesting talk on civil engineering touching frequently on the student side. Both Dean Kimball and Professor Barnes interested the students because they discussed affairs from the student viewpoint. Entertainment of a lighter vein was furnished by several novel and unique undergraduate stunts.

ALUMNI NOTES

'73. Ralph H. Lockwood has retired from active business and resides at 6326 Lakewood Avenue, Chicago, Ill.

'91. James P. Brownell was recently appointed Village Engineer at Carthage, N. Y.

'94. S. I. Kehler has just been appointed the Assistant Chief Engineer of the City of Baltimore, Maryland.

'95. Milo S. MacDiarmid has recently been promoted to Principal Assistant Engineer, U. S. Lake Survey, Detroit, Mich.

C. E. '95 M. D. John Weatherston is engaged in the practice of medicine with his office at 30 N. Michigan Ave., Chicago. His home address is 4230 So. Michigan Blvd., Chicago.

'99. Harry W. Dennis has changed his home address to 871 No. Kenmore Ave., Los Angeles, Cal.

'01. The Ferguson Construction Co., of which George A. Ferguson is president, has changed its offices to 403 Securities Bldg., Seattle, Washington.

'02. C. H. Snyder is City Engineer of Oswego, N. Y.

'07. Carl A. Gould is Superintendent of Construction for the Russell Engineering Company at Watson, Utah. His home address is 435 Humboldt St., Denver, Col. He is a member of the A. A. E.

'07. R. D. Jenkinson is in the Real Estate and Insurance Business at 507 Lincoln Ave., Bellevue, Pa. He resides at 15 North Howard Ave.

'07. Antonio Lazo has changed his business address to 115 Broadway, N. Y.

'07. Paul B. Lum is manager of the Washington Branch of the Autocar Sales and Service Co., 1240 Penna. Ave. N. W., Washington, D. C. He lives at 1361 Otis Place N. W.

'08. Harry Keohoe is Commissioner of Public Works at Oswego, N. Y.

'08 MCE '09. Ralph A. Smallman writes us that his home address is now Terrace Court Apartment, Birmingham, Ala.

'08. J. Wright Taussig, who is Assistant General Manager for the Raymond Concrete Pile Company of New York, advises us that his address is 465 Riverside Drive, New York City.

'09. Edwin R. Bowerman, who is with Bowerman Brothers, General Contractors, 230 Industrial Trust Bldg., Providence, R. I., resides at 9 Oakland Ave., Eden Park, R. I.

'09. Herbert B. Hoyt is Superintendent of timber in the Preserving Plant of the Buffalo, Rochester & Pittsburgh Railway at Bradford, Pa. His home address is 294 South Ave., Bradford, Pa.

'09. James N. Keenan is District Sales Manager

for the H. H. Robertson Company, 170 Broadway New York City. His home address is 461 West 159th Street.

'09. Charles J. Kehrhahn is Chief Draftsman with the New York Central and St. Louis Railroad, 530 Columbia Bldg., Cleveland, Ohio. He resides at 13600 Fourth Ave., East Cleveland, Ohio.

'09. William R. Ourand is Plant Engineer with the Willys Overland Co., of Toledo, Ohio. His home address is 4205 Eastway.

'09. MCE '10. The home address of Harry M. Spandau is 607 Flatbush Ave., Brooklyn, N. Y. Mr. Spandau spent a short vacation in Ithaca recently visiting Mrs. Spandau's mother, Mrs. Illston.

'09. R. B. Stanton, Jr., Sales Engineer of the U. S. Cast Iron Pipe and Foundry Co., has changed his home address to 7 Christopher St., New York City.

'09. George R. B. Symonds gives his home address as 39 Wayne Place, Nutley, N. J. He says that L. H. Faekiner, ex '18, is Assistant Town Engineer of Nutley.

'09. Bertrand Weiss is Secretary and Treasurer of the Berkshire Products Inc., 438 Broadway, N. Y. His home address is 279 Deatur St., Brooklyn, N. Y.

'10. Thomas S. Hauck has established himself in the lumber business at 717 S. Caroline St., Baltimore, Maryland.

'10. Herbert D. Kneeland has changed his home address to 230 Breeding Ave., Ben Avon, Pittsburgh, Pa.

'10. Percy S. Monk has been made Assistant to the Associate Engineer, 40th Street Bridge Project, Allegheny Co., Pa.

'11. Sewell Names is Superintendent of Construction for the Acheson Graphite Co., Niagara Falls, N. Y. His residence is at 194 Newfield Ave., Buffalo, N. Y.

'11. Major Claude M. Thiele is with the American Army of Occupation in Germany and may be addressed A. F. G. 927 Coblenz, Germany. His home address is 1742 Kilbourne Pl., Washington, D. C.

'11. Victor G. Thomassen has changed his address from Great Kills, N. Y., to 539 Madison Ave., Brooklyn. At present Mr. Thomassen is with the American Bridge Company at 30 Church Street, New York City.

'12. Charles A. Howland has changed his home address to 5822 Locust St., Kansas City, Mo.

'12. Hollister Johnson is Assistant Engineer of the Black River Regulating District, Watertown, N. Y.

ex '12. R. M. McCrone is Division Engineer, Royal Irrigation District, Bangkok, Siam. Me-

Crone returned to Siam shortly after the war.

'13. Leslie C. Frank is now Director of Public Health, Dallas, Texas.

'13. Paul Macy is the Rochester Representative of the Barrett Company, on Tarvia work for Western New York. His business address is Box 34, Brighton Station and his residence is at 43 Raines Park, Rochester.

'13. Roger W. Parkhurst has changed his business address to 233 Broadway, New York City, and his home address to 22 So. Portland Ave., Brooklyn, N. Y.

'13. Theodore L. Welles, Jr., is now residing at 1966 E. 83d St., Cleveland, Ohio.

'14. Ethan F. Ball, who is Assistant Engineer of the McClintic-Marshall Co., of Pittsburg, Pa., resides at 7127 Race St., Pittsburg, Pa. He is also an Associate Member of the A. S. C. E.

'14. Paul L. Heslop has just arrived in Philadelphia from Grants Pass, Oregon, where he has been doing irrigation work. Mr. Heslop is now the Manager of the J. B. Campbell Co., which specializes in hydro-electric developments.

'14. Benjamin S. Goodman's business address is 1328 Broadway, New York City. His home address is 1642 N. Monroe St., Baltimore, Md. He is a Junior Member of the A. S. C. E.

'14. Emory W. Lane is employed as a civil engineer and may be addressed in care of Grand Canal Improvement Board, Yang Chow, Kiangsu, China.

'14. Neil C. McMath has changed his home address to 1037 Iroquois Ave., Detroit, Mich.

'14. A. D. Newkirk, of Jacksonville, Florida, is now an Assistant Engineer of the Georgia State Highway Department with offices at Savannah, Ga., in the National Bank Building.

'14. Blinn S. Page, salesman with the Carnegie Steel Co., is now residing at 1530 Burlingame Ave., Detroit, Mich.

'14. G. G. Robinson is the Manager of the Dominion Lock Joint Pipe Company, Ltd., with offices at 502 Harbor Bldg., Toronto, Can.

'15. Williams H. Evans, Standard Oil Co., of Louisiana, has been transferred from Hong Kong, China, to 1206 Whitney Central Bldg., New Orleans, La. His address is 2321 West End Ave., Nashville, Tenn.

'15. Robert L. Glose has changed his residential address to 447 Rebecca St., Pittsburg, Pa.

'15. Seth G. Hess is now dealing in Real Estate, his office being located at 607 Fifth Ave., New York City.

'15. A. C. Meikle is Resident Engineer for Norton, Bird and Whitman on the construction of a \$2,000,000 development for the Maryland Casualty Co., of Baltimore, Md. His residence address is 3115 Clifton Ave.

'15. The Priester Construction Co., of which

Walter A. Priester is a member has moved its offices to 1006 Kahl Bldg., Davenport, Ia.

'15. J. E. Rosenthal is Secretary and Treasurer of the Gretsch Eng. Corp. at 103 Park Ave., New York City. His home is in Douglas Manor, L. I., N. Y.

'15. Gordon A. Sarstedt has changed his home address to 2352 Euclid Boulevard, Cleveland, Ohio.

'16. Walter P. Daly has established an engineering office at 1212 Otis Bldg., Philadelphia, Pa. His home address is 612 Washington St., Olean, N. Y.

'16. Warner Harwood is now a Junior Engineer, Department of Highways, Cook Co., Illinois. His home address is 824 Edgecomb Pl., Chicago, Ill.

'16. Harold L. Hoek is now Assistant Engineer N. Y. State Comm. of Highways, 703 Main St., Buffalo, N. Y. His home address has been changed to 19 Burwell Ave., Lancaster, N. Y.

'16. John R. McCarthy is a Junior Engineer with the Crew-Levieck Co., 111 No. Broad St., Philadelphia, Pa. He is engaged in statistical and accounting work. His permanent address is 4761 Richardson Ave., New York City.

'16. C. W. Middleton is engaged in selling and executive work for the Babcock-Wilcox Co., 85 Liberty St., New York City. He resides at 315 Clinton Ave., Brooklyn, N. Y.

'16. John L. Ober is a member of the Carson Construction Co., Box 180, Savannah, Ga. He resides at 143 Abereom St.

'16. Theodore C. Rogers has changed his home address to 172 First Ave., Pheonixville, Pa.

'16. George P. Spear, Jr., is still with the New York Telephone Co., 104 Broad St., New York City. His home address has been changed to 186 Bloomfield Ave., Passaic, N. J.

'17. J. J. Fuchs, Sales Engineer for the Truseon Steel Co., has been transferred to the Chamber of Commerce Bldg., New Haven, Conn. His home address is 334 E. 17th St., New York City.

'17. T. W. Hacker is with Norton, Bird and Whitman, Engineers and Contractors of Baltimore, Md. He is a member of the Engineers' Club of Baltimore. His home is in the Woodcroft Apts., Catonsville, Md.

'17. Ernest W. Kurz is Assistant Engineer for Schenck & Williams, 907 Mutual Home Bldg., Dayton, O. His home address is 910 Five Oaks Ave., Dayton, Ohio.

'18. Frank V. Fields, is now Section Engineer, Obras Publicas, La Vega, Dominican Republic, West Indies. His home address is 21 Serrill Ave., Binghamton, N. Y.

'19. Charles J. Howell is now Sales Engineer for the Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa. His home address is 928 Western Ave., Pittsburgh, Pa. He writes that Henry E. Lindberg '19 is also connected with the same company.

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EZRA B. WHITMAN

Continued from page 153)

ing laboratory, and the design and construction of the sewage disposal works for Baltimore.

In 1911 he was appointed chief engineer and president of the Water Board of Baltimore and had charge not only of the operation and maintenance of the water system, but of the design and construction of \$5,000,000 worth of improvements and extensions, including filtration plant, concrete dam, large distributing conduits, and two pumping stations.

In 1914 he became a member of the consulting engineering firm of Greiner and Whitman, working on water supplies, sewerage systems, bridges, and buildings throughout the East and South.

In 1916 he became a member of the firm of Norton, Bird and Whitman. William J. Norton '02 and Paul P. Bird '00 are the other members of the firm.

In May, 1917, Whitman was employed in a civilian capacity as assistant to the Construction Officer of the Construction Division of the Army. He was commissioned as major, Q. M. C., on September 7, 1917, and sent to Camp Meade as Officer in Charge of Utilities and succeeded Lieut. Col. R. F. Proctor '01, as constructing quartermaster of this camp.

Directly following his resignation from the Army in May, 1919, at the invitation of the Polish National Commission, he went to Poland with E. H. Bouton to investigate municipal and housing conditions throughout Russian Poland.

He has recently been appointed a member of the Public Service Commission of the State of Maryland, and elected a member of the Board of Directors of the Atlantic Trust Company of Baltimore.

Mr. Whitman was one of the organizers of the Cornell Alumni Association of Maryland, and was its first president for two years. He is the president of the Baltimore Section of the American Society of Civil Engineers and also president of the Baltimore Engineers' Club. He had charge of the reorganization of this club, and in the last six months has built its membership up from two hundred and twenty-five members with dues of \$12 per year, to over seven hundred members with dues of \$25 per year. He is a member of the American Society of Civil Engineers, the American Waterworks Association, the New England Waterworks Association, the American Public Health Association, Kiwanis, and the Baltimore Club.

He is a member-at-large of the Cornellian Council and a director of the Associate Alumni.

H. N. HOWE

Continued from page 153)

to being a straightforward, capable and thoroughly likable man, Mr. Howe stands high in the estimation of the other members of his profession as an engineer of note. He will, I feel sure, carry out the ambitious program mapped out by Commissioner Allen and will secure the best results for the city at a minimum cost.

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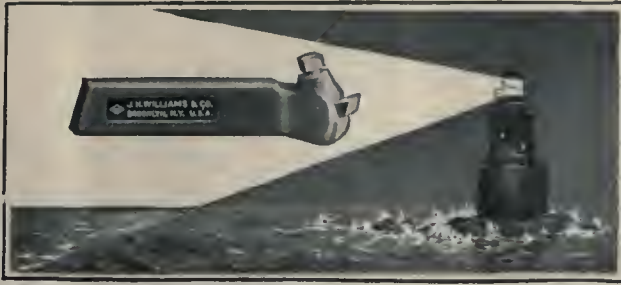
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Dr. George M. Price, writing on "The Importance of Light in Factories," in "The Modern Factory," states: "Light is an essential working condition in all industrial establishments, and is also of paramount influence in the preservation of the health of the workers. There is no condition within industrial establishments to which so little attention is given as proper lighting and illumination. Especially is this the case in many of the factories in the United States. A prominent investigator, who had extensive opportunities to make observations of industrial establishments in Europe as well as in America, states: "I have seen so many mills and other works miserably lighted, that bad light is the most conspicuous and general defect of American factory premises."

"My own investigations for the New York State Factory Commission support this view. In these investigations it was found that 36.7% of the laundries inspected, 49.2% of the candy factories, 48.4% of the printing places, 50% of the chemical establishments, were inadequately lighted. There was hardly a trade investigated without finding a large number of inadequately lighted establishments."

Inadequate and defective lighting of industrial buildings is not confined to the establishments in New York State alone. The same conditions prevail in most sections of the country.

Such conditions as mentioned above are entirely opposed to the laws of health, sanitation and efficiency. Wherever poor lighting conditions prevail, there must be a corresponding loss of efficiency and output both in quality and in quantity. American industry is not using nearly enough daylight and sunlight in its buildings. Every endeavor should be made to use as much as possible of daylight for lighting purposes. To obtain this it is of course necessary that the rays of daylight and sunlight are permitted to enter the interior of the buildings as freely as possible, with the important modification that the direct rays of the sun must be properly diffused to prevent glare and eyestrain. A glass especially made for this purpose is known as Factrolite, and is recommended for the windows of industrial plants. Windows should be kept clean if the maximum amount of daylight is to pass through the glass, but the effort will be well repaid by the benefits secured.

In the presence of poor lighting, we cannot expect men to work with the same enthusiasm as when a well lighted working place has been provided. The physical surroundings have a deep effect upon the sentiments of the employes, and where bad working conditions are allowed to prevail, there is invariably a lessening of morale and satisfaction created thereby. Neglecting to utilize what nature has so bounteously provided, daylight, and which is so essential toward industrial efficiency, we have an instance of wastefulness, but now that the importance of good lighting is becoming recognized, undoubtedly more attention will be given by progressive industrial employers to furnishing the means which are essential for their workers to secure and maintain the efficiency, which counts for so much in the success of any industrial concern in this competitive age.

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Cornell Co-op. Society

MORRILL HALL

ITHACA, N. Y.

AN INVESTIGATION OF THE ONE-HINGED ARCHES

(Continued from page 152)

is a little less than that on the no-hinged arch, and much greater than that in the two-hinged arch. For the same amount of horizontal movement, the increase in the horizontal reaction in the two-hinged arch is 29.8 kips, while that in the no-hinged arch is 161.0 kips. Thus, we see that a perfectly firm foundation is required for these three types of arches.

Remarks

The main feature of this investigation consists in the discovering new formulas and relations for the one-hinged arch. These formulas and relations are then carefully studied with the aid of numerous curves and diagrams, and their characteristics are revealed by means of critical comparisons. Although the main purpose of this thesis consists in searching for new theoretical facts, it is hoped that it may stimulate investigations in a practical treatment of the one-hinged arch with regard to its design and construction. The knowledge of the subject, however, is still in its infancy. Notwithstanding the large amount of study and the labor devoted to the subject treated in this thesis, other subjects remain to be investigated, such as the economic ratio of rise to span, the relative merits of solid and open webs, the secondary stresses, etc.

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PUBLISHED MONTHLY DURING THE COLLEGE YEAR BY
The Association of Civil Engineers of Cornell University, Ithaca, N. Y.

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The CIVIL ENGINEER takes pleasure in announcing the elections of Arthur W. Crouch '23, of East Aurora, N. Y., and Ernest W. Downs '23, of Danbury, Conn., to the Junior Business Board, as a result of the competition just ended. The board also wishes to express its appreciation of the excellent work performed by Mr. Howard '23, until he was taken sick and forced to withdraw from the competition.

A Statement of Policy With this issue the 1921-22 board of the CIVIL ENGINEER takes over control of the magazine. We regret that we must begin our term of office with apologies, such as are due for the late appearance of the May issue and of this issue. For once however the delay is due neither to the work of the Board nor to the printer. The recent printers' strike, which started on the first of May, has disrupted the printing trade more or less all over the country and in Ithaca mostly more, and it is only due to the untiring efforts of the printer that the May issue and this issue appeared anywhere near on time or even at all.

It will be the policy of the new board to continue as its predecessors have done to publish articles that will be of interest to both the engineer and the student, and we ask that in the preparation of these articles all alumni take an active part. In the past articles have been received mainly from those who are the leaders in the profession. Those who are not the leaders however must have ideas on subjects of professional interest which would prove interesting to others, or have seen or heard of new or novel methods of treatment of work or materials in their line. Possibly the thing may seem trivial to you, or upon investigation seem to be so simple that it is self-evident, and really needs no explanation. However it was something new to you, why shouldn't it be new to others? It was something that interested

you, why wouldn't it interest others who are in your same line of work? Francis Bacon in one of his essays says that writing develops clear thinking. Why not develop a little clearer thinking ability which will help you out and at the same time help us out?

Sometime in the long distant past the idea has arisen that student articles are not acceptable, and with that view prevalent the only student articles which are ever published are occasional abstracts of theses and the annual report of the Chief Engineer of the Sophomore Camp. We state emphatically that this idea is absolutely false and about as far from our true intentions as anything could be. We will be glad to publish any student articles received provided only that they are of sufficient merit to make interesting reading for the majority of our readers.

And finally of course it is our aim to keep our alumni interested in the college, and informed about what is going on in the college, and to increase the amount of Cornell Civil Engineering Spirit that there is in circulation, and to keep the student body more or less acquainted with what the alumni of the college are doing, have done, and hope to do.

In conclusion we ask only that the present board in order to carry out its design and purpose, receive the support of alumni and students that other boards in the past have received. With it we believe that the Civil Engineer can hold its rank as one of the best if not the best of the college technical magazines.

The forerunner of the present June List was published for the first time in Volume One of the "Transactions of the Association of Civil Engineers" in 1893. The old "Transactions" were published annually and contained about ten or fifteen pages devoted to a list of the members of the Cornell Association of Civil Engineers, the rest of the publication being abstracts of lectures delivered before the association during the year. This

(Continued on Page X)

MEMBERS OF THE ASSOCIATION OF CIVIL ENGINEERS CORNELL UNIVERSITY

All graduates of the College of Civil Engineering up to and including 1921

The home or permanent address is given on the line with the name, and the business or more temporary one on the line below. When only one is given its position is an index of its permanency, except when forced from one position to the other by lack of room. The addresses in italics are unreliable. All changes in address should be reported promptly to the Corresponding Secretary.

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Abbott, Clark D *CE* '15—23 Bowers St Newtonville Mass
Asst Engr Associated Factory Mutual Ins Co Boston Mass
*Acklart, Andrew L *CE* '11 AMASCE MAAAS 1864 E 71st st
Engr Boldt Constr Co 5902 Euclid Ave Cleveland O
Adair, Arthur P *BCE CE* '99—Indianhead Md
Mngng Engr Indianhead Power Plant Constr
Adams, Arthur *CE* '01 MASCE 1022 Bedford Ave Brooklyn NY
Vice-Pres Adams Evans & Co 410 Atlantic Nat Bank Bldg
Jacksonville Fla
Adams, Morris H *BS in CE CE* '09—Princess Anne Md
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Addams, William Jr *CE* '17—502 E Pike St Cynthiana Ky
Grain Business 109 So Main St
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2725 Colfax Ave So Minneapolis Minn
Pres Twin City Trading Co 106 Chamber of Commerce
*Agate, Elroy T *CE* '97—MAREA MEIC Pittsford N Y
Ageoilli, Romarico *CE* '08
MPH Inst E & A Laoag Ilocos Norte P I
*2d Asst to Director of Public Works Manila P I
Aguilar, Juan E *CE* '08—McNSE Santiago de Cuba
City Engr and Mem Firm Chalors & Aguilar Engrs & Contrs
*Aitchison, William M *CE* '12—18 King St Morristown N J
Lehigh Power Securities Co Hunsicher Bldg Allentown Pa
Alexander, Fred B *CE* '74 606 California St Newtonville Mass
Rattan Manufacturer 42 Everett St Allston Mass
Alexander, Henry D *CE* '93 MASCE MAHSCE 44 Terrace Ave
Sen Asst Engr Dept State Engr Barge Canal Office Albany
Allen, G James *CE* '12—Bethany Man Can
Allen, Gardner P *BS in CE CE* '16—618 Church St Flint Mich
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Farmer & Stockman
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Civil Engr Rust Engrg Co 504 Dist Nat Bank Bldg Wash D C
*Anderson, Robert H *CE* '98—AMASCE Sunnyburn Pa
Res Engr J G White Engrg Corp Box 120 Syracuse N Y
Anderson, William C *CE* '14—662 Decatur St Brooklyn N Y
Engr Stadium Constr Montclair Acad Montclair N J
Andrew, Earl R *CE* '21—22 Park Ave Danbury Conn.
Andrews, Don E *CE* '05—Fairhope Ala
Fruit Grower
Andrews, Harry S *CE* '15—JASCE Fulton N Y
Andrews, William A *CE* '21—532 Lafayette St Grand Haven
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Armstrong, John E *CE* '08 MAREA AMEIC 2358 Hutchison St

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Junior, JASCE.

The American Railway Engineering Association, MAREA.

The American Association of Engineers, MAAE.

The American Society for Testing Materials, MASTM.

The Engineering Institute of Canada, Member, MEIC.
Associate Member, AMEIC.

For membership in the other societies the names are similarly abbreviated.

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Asst Mgr John F Byers Mach Co Ravenna O
Arnold, Carter A *CE* '09—Elberton Ga
Wholesale Grocer and Broker
Arrastia, Justo *CE* '21—Lubao Pampanga P I
Arronett, Margaret G *CE* '21—Petrograd Russia
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Chargeman U S Naval Station Newport News Va
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Austin, Herbert A R *CE* '13 AMASCE MHEA Wailuku Maui
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Sales Engr Truseon Steel Co 314 Woodward Bldg
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Mem Firm Higgins Bros & Co 17 E Main St
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*Bacon, George M *CE* '93—MASCE MNEWWA MUTSCE
Cons Engr 311 Newhouse Bldg Salt Lake City Utah
Badger, Henry F Jr *CE* '03 727 Edgemont Blvd Los Angeles Cal
Bahjejian, Kevork P *CE* '21—Kasta Armenia
e/o J G White Management Corp Ithaca N Y
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San Engrg W Palm Beach Fla
Bailey, Earl B *CE* '94—1228 Edward St Lakewood O
Traveling Salesman
Bailey, John D *CE* '00—870 W Market St Lima O
Chief Engr The Buckeye Pipe Line Co 137 W North St
Bailey, John S *CE* '14—614 Madison Ave Montgomery Ala
Heriot & Co Jeff Co Bank Bldg Birmingham Ala
Bain, Patterson Jr *BS in CE MCE* '10—R F D 6 Columbia Mo
Farmer
*Baker, Charles H '86—MASCE MAIEE Mohegan Lake N Y
Pres Palm Beach & Everglades R R V-P Amer Cynamid Co
V-P Muscle Shoals Hydro-Elect Co
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- *Baker, Edwin S CE '15-----9610 Clifton Blvd Cleveland O
See A B Smythe Real Estate Co
- *Balcom, H Gage CE '97-----MASCE Cornwall-on-Hudson N Y
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- *Baldwin, Ernest H CE '92-----MASCE Cornwall-on-Hudson N Y
- *Ball, Ethan F CE '14-----AMASCE 7127 Race St Pittsburgh Pa
Desnr & Estmtr McClintie-Marshall Constr Co
- *Ballard, Wilson T CE '16-----1622 Mt Royal Ave Baltimore Md
- *Balser, Lewis F CE '17-----2520 N Sixth St Harrisburg Pa
- *Baltasar, Apolinario CE '08 MPH Inst E&A 533 Reyna Regate
Superintendent Street Constr & Bridges Manila P I
- *Banks, John E CE '92-----MASCE FAAAAS Knoxville Ia
Assistant Engineer American Bridge Co Ambridge Pa
- *Banta, Russel V CE '09
AMASCE 236 Sisson Ave Hartford Conn
Dist Engr Lockwood Greene & Co 101 Park Ave N Y C
- Barbour, Armour W CE '12-----523 W 112th St New York City
Salesman National Bridge Works Inc Long Island City N Y
- *Barbour, Irvin W CE '94 MMEAE 28 Belknap St Woodford
Asst Engr State & Fed Aid Hwys State House [Me
Augusta Me
- Bardol, Frank V E CE '89-----MASCE Buffalo N Y
Engineer & Contractor 402 D S Morgan Bldg
- Barnard, William H Jr CE '13 1011 Woodbourne Ave Govans
Asst Engr M W & S Southern Ry Charlotte N C [Md
- *Barnes, Fred A CE '97 MCE '98
AMASCE MAREA MASTM MAAE FAAAAS
Director School Civil Engrg & Prof Railroad Engrg Cornell
Univ Ithaca N Y
- Barnes, Morris H CE '18-----74 Beaver St Brooklyn N Y
- *Barnhart, George D CE '16-----MAAE Clayton N Y
Asst Rdwy Val Pilot N Y C R R Gr Cent Term N Y C
- Baron, Edward V BS CE '10-----AMASCE
Contracting 809 Empire Bldg Detroit Mich
- Barros, Carlos Paes de CE '76-----MHInstSP Sao Paulo Brazil
Coffee Planter & Pres Textile Co Rua Sa Ifigenia No 20
- *Barton, Calvin L CE '99-----MASCE New York City
Engr and Contr McHarg-Barton Co 1328 Broadway
- Barton, George T CE '17-----Montour Falls N Y
Sales Engr Seneca Engrg Co
- *Barzaghi, Arthur J CE '10-----AMASCE Stamford Conn
Estimator Turner Constr Co 244 Madison Ave N Y C
- Bassett, Harold R CE '19 JASCE 714 Dwight St Holyoke Mass
Engr of Mines Union Pacific Coal Co Rock Springs Wyo
- *Bassett, Herbert H CE '02 MASCE 11 Iowa St Worcester Mass
General Manager Groton Bridge Co Groton N Y
- *Bassler, Robert E CE '17
MAAE 683 De Kalb Ave Brooklyn N Y
Aerontel Engr Bur Constr & Rep Navy Dept Washington D C
- *Bates, Carl A CE '13-----15 Clyfton St Plymouth Mass
Engineer 10 Oakley St Boston Mass
- Batjer, Henry H CE '17-----546 Hickory St Abilene Tex
Assistant Engineer City of Abilene
- Batley, Edward A CE '15-----72 Heartt Ave Cohoes N Y
- Battin, Henry W CE '81 1964 Kenwood Pkwy Minneapolis Min
Supt Winston Bros Co
- *Bauer, Charles F CE '13-----AMASCE 520 W 114 St N Y C
Res Engr Mason & Hanger Co Gettysburgh Pa
- Baughner, William H CE '14-----38 N Fulton Ave Baltimore Md
- *Baum, John A BS in CE CE '05
MAAE 42 Steuben St Crafton Pa
Asst Engr Corps Pa Lines W 1013 Penn Ave Pittsburgh Pa
- *von Bayer, August H CE '00 MASME MAIME 33 Walnut Ave
Superintendent Semet-Solvay Co Wheeling W Va
- *Beahan, Willard CE '78
MASCE MAREA MAAE 2213 Bellfield Ave
Asst Engr N Y C R R Rm 5 Gen Offices Cleveland O
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Building Contractor
- Beale, David CE '17-----Careywood, Idaho
Ranchman
- Bean, Milford C CE '72-----24 E Academy St McGrawville N Y
Civil Engineer & Surveyor
- *Beardsley, James W CE '91
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Engr Mem Cent Hwy Comm Rep of Panama Hotel Tivoli
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- Bechel, Charles H CE '15-----2803 W Tuscarawas St Canton O
- *Beek, Charles S CE '17-----3232 Collingwood Ave Toledo O
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- Becker, Charton L CE '88 R D 1 Philadelphia Jefferson Co N Y
- *Beekman, Carl T CE '15-----249 Main St Northampton Mass
Wholesale Confectionery Business
- Bee, Charles E AB MCE '15 AMASCE RFD 1 Stephentown NY
Dairy Farming
- Beebe, Roscoe C CE '92 MEmptTeeCl 818 Water St Elmira N Y
Engr in Chg R R Details Elmira Plant American Bridge Co
- Behrman, I Ellis CE '10-----AMASCE 1121 E Baltimore St
[Baltimore Md]
- Beitz, William E CE '13-----316 W Center St Medina N Y
Captain and Adjutant U S A Germany
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Gen Mgr E S Belden & Sons Inc 217 Laurel St Hartford Conn
- *Belden, George A CE '12
MAREA AMASCE 119 W Oglethorpe Ave
Architect Cent of Ga Ry Savannah Ga
- Bell, Harold I CE '05-----AMASCE 22 Craigie St Portland Me
Mgr Br Off H P Cummings Constr Co 409 Fidelity Bldg
- Bell, Nelson J CE '04-----MECID 1014 Redfern Ave Dayton O
Sehenck & Williams Archts 908 Mutual Home Bldg
- *Bellinger, Lyle F CE '87 MASCE Navy Dept Washington D C
Cmdr U S N Pub Works Officer 8th Naval Dist New
Orleans La
- Beltaire, Mark A Jr CE '02-----51 Lawrence Ave Detroit Mich
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Mem E W Bemis Co 139 N Clark St
- Benisch, Henry J CE '20-----895 Jamaica Ave Brooklyn N Y
- Bennett, Curtis B CE '19 JASCE 507 W Main St Richmond Ky
Jun Asst Engr Cleveland Ry Co Cleveland Ohio
- Bennett, Ralph S CE '20-----
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- *Bennett, Rowland K CE '18-----Philadelphia Jefferson Co N Y
McHarg-Barton Co Navy Yard Washintgon D C
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Instructor Sibley School of Mech Engrg Ithaca N Y
- *Benson, Orville CE '88-----MASCE Pequannock N J
American Bridge Co 30 Church St New York City
- Benson, Walter V CE '17-----Chatham N Y
- Bent, Reginald W CE '13-----
Asst Engr Hydrog Survey Dept Naval Serv Ottawa Can
- Berman, Herman CE '18 1218 E Shepherd St NW Washington
Assistant Examiner of Patents [D C
- *Bermel, Peter E CE '15-----MAISCE 450 Morris St Albany N Y
- Bernstein, Max CE '16-----771 Irving Ave Syracuse N Y
Concrete Designer Trusecon Steel Co 440 Gurney Bldg
- *Berry, Harry V W CE '13-----202 Orient Way Rutherford N J
- Bertolet, Hyman E CE '99-----Oley Berks Co Pa
Engineer
- Bertran, Juan M CE '18-----P O Box 135 Humacao P R
- *Beyne, John C CE '83-----MAREA MWeSE 1040 Wash Blvd
With the I C C Div of Val Chicago Ill [Oak Park Ill
- Bidgood, Carlos F CE '14-----381 Myrtle Ave Albany N Y
Hwy Engr US Bur Pub Roads Court House Omaha Neb
- *Biele, Frederick J CE '09-----7622 Seventh Ave Brooklyn N Y
Sales Engr 152 Chambers St New York City
- *Bilderbeck, George L CE '06 AMASCE MChnSCE Groton Conn
Pres Bilderbeck & Langdon Inc New London Conn
- *Bird, Matthew M BS CE '12 AMASCE MAAE 414 Cherry St
[Ranger Tex
Chief Engr Smith Co Hwy Comm Box 182 Carthage Tenn
- *Birkhahn, Jacques CE '08-----MAAE 51 E 129th St
Asst Engr Transit Constr Comm [New York City
- Birnbam, Milton CE '12-----Trudeau N Y
- Birner, Isador L CE '10-----MAAE AMASCE
Dist Sales Mgr Graver Corp 220 Gwynne Bldg Cincinnati O
- Bisbee, Ben H CE '01-----523 Essex Road Kenilworth Ill
Contracting Engineer 175 W Jackson Blvd Chicago Ill
- *Bishop, Hubert K CE '93-----MASCE Warsaw N Y
Gen Insp Bur Public Roads Washington D C
- *Bissell, Frank E CE '78 MCE '79 MASCE 10515 Wilbur Ave
Chf Engr A S Hecker Co 8701 Union Ave [Cleveland O
- *Blake, Henry E CE '73-----Elsmere N Y
Asst Engr N Y State Hwy Dept 53 Lancaster St Albany N Y
- Blakeslee, C Albert CE '03-----110 W Front St Clearfield Pa
Chief Engineer Jefferson Coal Co Coal Glen Pa
- Blanco-Morales, H CE '15-----Santuree P R
Asst Engr Empresa Constructora del Puerto Ceuta Africa
- *Blatch, Nora S CE '05-----Greenwich Conn
Liggett Building New York City
- Blaylock, John C BCE CE '07 MWSE 1232 Lake Ave Wilmette
Pres Lake View Iron Wks 53 W Jackson Blvd Chicago Ill [Ill
- *Blickman, Saul CE '11 Nelson Ave & Mount Stn Long Island
Manufacturer Metal Specialties 199 Lafayette St [City N Y
New York City
- *Blinn, Thomas W CE '12-----749 Crawford Ave Detroit Mich
Draftsman City of Detroit St Rwy
- Bliss, Clarence R CE '11-----AMASCE 89 Chestnut St N Adams
Asst Engr Power Constr Co Worcester Mass [Mass
- *Blog, Leon CE '15-----5419 Fountain Ave Akron O
Ind Engr Goodyear Tire & Rubber Co
- Blundon, J Paul CE '17 JASCE MAAE JWWaEA Riverdale Md
c/o State Road Comm Martinsburg W Va

- *Bobker, Harry CE '18-----54 Thatford Ave Brooklyn N Y
res Bobker Constr Co 16 Court St
- Boesch, Clarence E CE '06-----AMASCE Durham N C
Engr with Gilbert C White Box 562
- Bogart, Robert D CE '08-----620 W Second St Little Rock Ark
- *Bogert, Clinton L CE '05-----AMASCE Elm St Teaneck N J
Designer Clyde Potts 30 Church St New York City
- *Bolger, Edwin G CE '13-----1107 19th Ave Altoona Pa
Dist Engr Peabody Coal Co P O Box 168 Marion Ill
- *Benner, John P CE '12 AMASCE 92 Euclid Ave Waterbury
Res Engr Greenbrier & Eastern RR Rainelle West Va [Conn
- Boorstein, Joseph A AB CE '05-----344 80th St Brooklyn N Y
Asst Engr Finance Dept Room 610 Mun Bldg N Y C
- *Boeth, Raymond CE '10 AMASCE 30 Center St City Island
Engr C V York Cons Co 127 W Martin St Raleigh N C [N Y
- Booth, Russell C CE '11-----Groton N Y
431 S Grand Ave Los Angeles Calif
- Borges, Domingos G CE '15 Praea Justo Chermont 5 Para Brazil
Railway Engineer
- *Boright, William P CE '92 MCE '94-----Chatham N Y
With J W Boright Lumber Co
- *Borst, George C CE '14-----103 No Seventh St Wilmington N C
Aberthaw Constr Co Beverly Mass
- *Boshard, John A CE '13-----472 E Second St Provo Utah
Vice-Pres First National Bank Telluride Col
- Bowen, Corydon H CE '93-----Belle Plaine Ia
Train Master C & N W Ry
- *Bowerman, Edwin R BS CE '09 MAAE 9 Oakland Ave Eden
Bowerman Bros Gen Contrs 230 Ind Trust Bldg [Park R I
Providence R I
- Bowes, Thomas F CE '91-----MBosSCE Boston Mass
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- *Bowles, Albert M CE '14-----305 Avondale Ave Houston Tex
Vice-Pres & Gen Mgr Texas Concrete Constr Co
- Bowles, Robert B CE '20-----305 Avondale Ave Houston Tex
Civil Engr e/o James Stewart Co Humble Oil Bldg
- Bowman, Ralph M CE '09-----AMASCE 1475 Columbia Rd Wash
Asst P A Otis Steel Co Leader-News Bldg Cleveland O [D C
- *Bowman, William L CE '04-----MILHavS of NY 1522 Jessup Ave
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- *Boyajohn, II Milton CE '08-----MASCE
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- Boynton, Edmund P CE '93-----852 Second Ave Cedar Rapids Ia
Merchant 117 So First St
- *Bracho, José CE '14-----2a de Napoles 34 Mexico City Mex
Geodetic Engr Geod Exp in Yucatan Ap 255 Merida Yuc
Mex
- Brady, Samuel D Jr CE '21 1201 Fairmont Ave Fairmont W Va
- Brainard, Albert S CE '05 AMASCE 87 N 18th St E Orange N J
Engineer Salesman Standard Oil Co 31 Clinton St Newark N J
- *Brainerd, Harold A CE '07-----AMASCE 3905 Hawthorne Ave
Engr Am Bridge Co 600 Continental Bldg Baltimore Md
- Bramhall, William E CE '77 LLB Aberdeen Hotel St Paul Minn
- *Brandes, Fred C CE '16 Mamoreneck Rd & Sterling Ave White
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- Branin, Frank H CE '11-----181 So Eleventh St Newark N J
Str Dsnr Hay Foundry Iron Wks 15 E 26th St N Y C
- *Braunworth, Percy L CE '06-----MASCE Roseland N J
Ind Engr 771 Broad St Newark N J
- Brewer, Isaac CE '89-----334 Huron Ave Sandusky O
Supt Center Liberty Potash Co Green River Wyo
- Briede, Otto F Jr BE CE '09-----416 Girod St New Orleans La
Asst City Engineer 201 New Orleans Court Bldg
- *Briggs, Chauncey M CE '17-----6530 Yale Ave Chicago Ill
Office Mgr Maher Engrg Co 30 No Michigan Blvd
- *Brigham, John C CE '08-----16 Shadyside Ave Summit N J
City Engineer City Hall
- Bright, Joseph P CE '17-----1303 Franklin St Wilmington Del
Bethlehem Shipbuilding Co 59 Davis St Wollaston Mass
- Bright, William R CE '00-----5716 Cates Ave St Louis Mo
Treas J H Bright Contrg and Bldg Co
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Sales Engr American Auto Parts Co
- *Bronson, Howard F CE '10-----AMASCE Harrisburg Pa
Chf Rural San Sect Engrg Div State Dept Health
- Brooks, Ernest PhB CE '03-----Cedarhurst N Y
Starrett & Van Vleet Archts 8 W 40th St N Y C
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- *Brooks, Landon M CE '14-----1835 Bolton St Baltimore Md
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- Brooks, William E CE '13-----616 Fairmont Ave Fairmont W Va
Gen Supt H C Brooks Co Inc Martinsburg W Va
- Brower, Gerald E CE '16-----MFAA Langley Field Va
Capt U S Air Service
- Brower, Irving C CE '01-----MASCE MAWWA 34 Liberty St
City Manager Pontiac Mich
- *Brower, Milton W CE '11-----64 Wathery Ave Ridgewood N J
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- Brown, Collingwood B Jr CE '01 MASCE MAREA MEIC Ithaca
Engr Asst Canadian Govt Rys Toronto Ont Can [N Y
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- *Brown, Edgar T BCE CE '01 MAREA 1006 Weld St Little
Civil Engr P O Box 747 Clarksburg W Va [Rock Ark
- Brown, George A CE '05-----3300 St Mary's Ave Hannibal Mo
Jeweler 307 Broadway
- *Brown, Grover C CE '06 MCE '09 MASCE 204 Fairmount Ave
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Johnstown Pa
- *Brown, Homer C CE '97-----Selah Yakima Co Wash
Fruit Grower
- *Brown, John W CE '12-----53 Ludlow St Waterbury Conn
Asst Engr McClintic-Marshall Constr Co Pittsburgh Pa
- Brown, J Winthrop CE '14-----614 W 148th St New York City
Engineer Guarantee Constr Co 140 Cedar St
- *Brown, Leigh A CE '12-----102 Eighteenth St Buffalo N Y
Chief Engineer Iroquois Gas Co 311 Iroquois Bldg
- Brown, Leon R CE '11-----76 Winton Road S Rochester N Y
Engr in Ch Des & Tech Wk N Y State Rys 267 State St
- *Brown, Morris E CE '12-----43 Hawthorne Place Montclair N J
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- Brown, N Adelbert CE '03 MRES 152 Post Ave Rochester N Y
Special Assistant Engineer 52 City Hall
- *Brown, P DeWitt CE '13-----235 Chestnut St Sewickly Pa
Drftsm & Designer Fort Pitt Bridge Works Pittsburgh Pa
- *Brown, Rodney D CE '13-----3215 17th St NE Washington D C
Highway Engineer
- Brown, William CE '93-----Belvidere N Y
Farming
- Brownell, James P CE '91-----MASCE Carthage N Y
Consulting Engineer 19 Strickland Bldg
- *Brien, Frank CE '78-----69 Prospect St Bristol Conn
Cost Engr The Sessions Foundry Co
- Bryan, Lemuel B J BCE CE '05-----AMASCE
Supt Adams Evans & Co Thomasville N C
- *Bryson, Thomas B CE '94-----AMASCE
Contractor, 52 Vanderbilt Ave New York City
- Buchanan, George P CE '14-----6113 Howe St Pittsburgh Pa
Gen Sales H J Heinz Co
- Buck, John A CE '15-----North Warren Pa
- *Buckman, George F CE '17-----Queen Anne Road Teaneck N J
Drftm and Asst Shop Engr NY Shipbuilding Corp Camden NJ
- *Budd, Percy H CE '09-----AMASCE 84 Mt Ave Summit N J
Eff Engr Lowenstein Radio Co 397 Bridge St Brooklyn
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- Bullard, George P CE '18-----500 Todd St Wilkinsburg Pa
Draftsman McClintic-Marshall Constr Co
- Bullis, Abram R BS CE '82-----Macedon N Y
- Bunn, Charles H Jr CE '17 MAPI 143 So Munn Ave E Orange
Civil Engineer Standard Oil Co Elizabeth N J [N J
- Burdick, Roy D CE '14-----Cuyler N Y
Captain U S A 3d Engrs Schofield Barracks T H
- Burés, Antonio S CE '12-----Adjuntas P R
Asst to Chief Civil Engr So P R Sugar Co Ensenada P R
- *Burgard, Willard H CE '16-----30 Burgard Place Buffalo N Y
Care of Lackawanna Steel Co
- *Burkhart, Ernest D CE '13-----482 Delaware Ave Albany N Y
Engr Grade Crossings N Y State Pub Serv Comm 2d Dist
- *Burnell, Eugene D CE '06-----MASCE 575 Riverside Dr N Y C
Rm 604 Citizens Bank Bldg Atlanta Ga
- *Burnham, Clifford J CE '14-----MAAE 3811 Seneca Ave Los
Sen Civil Engr Los Angeles Co Flood [Angeles Calif
Control Dist
- *Burnham, E Lewis AB CE '07-----Berwyn Pa
1301 Morris Bldg Philadelphia Pa
- *Burrage, John D CE '14-----337 Washington St Newton Mass
125 Washington Place N Y C
- *Burrows, Earl N CE '07 MCE '14-----MAREA 214 Bryant Ave
Asst Prof Bridge Engrg School of Civ Engrg [Ithaca N Y
- *Burt, LeVan M CE '01-----Guilford N Y
Asst Engr Bur of Highways 940 President St Brooklyn N Y
- *Burton, Floyd E CE '13-----575 Humboldt St Denver Colo
Partner Burton Seed & Prod Co 1500 Market St
- *Burton, Frank H CE '13-----2038 Fairfax St Denver Colo
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Engineer South Penn Oil Co Pittsburgh Pa
- *Burwell, Robert L CE '01.....MAAE MASCE 2446 Twentieth St
Aid Bur Yds & Docks Navy Dept Wash D C [N W
Bush, Harold W CE '21.....Warsaw N Y
- *Butchers, Earle B CE '01.....604 Park Road Ambridge Pa
- Butler, William M CE '01.....309 Plum St Syracuse N Y
Vice-Pres & Treas Butler & Bedden Inc 950 Canal St
- *Button, Ernest D CE '99.....449 No Aurora St Ithaca N Y
Pres J B Lang Engine and Garage Co 117-129 E Green St
- Butts, Harry W CE '11.....52 William St E Orange N J
Manager Hedden Place Machine Co Inc 40 Hedden Place
- Cacho, Mariano M CE '16.....233 Gral Luna Manila P I
- *Cadiz, Alvin G CE '15.....473 Fourteenth St Brooklyn N Y
Engineer Willys Corp 87 Lincoln Park Newark N J
- *de Camp, Horace S CE '09.....317 Riverside Drive N Y C
Treasurer 56 Commercial St Brooklyn N Y
- *Campaneria, Juan M AB CE '13.....MCuSE Consulado 114 Alt
Dist Engr Cuba Cane Sugar Corp Central [Havana
Perseverencia Pr Sta Clara Cuba
- Campbell, Harry G CE '14.....Windsor Hills Baltimore Md
Supt Henry Smith & Sons Co Shipbuilders
- *Campbell, John B BS CE '14.....324 Church Ave Roanoke Va
Hydr Engr J B Campbell Co Bourse Bldg Phila Pa
- *Canaga, Gordon B AB CE '07.....AMASCE 140 No Broad St
Sen Engr Emergency Fleet Corp [Phila Pa
- Canfield, G Howard CE '10.....AMASCE
Hydraulic Engineer USGS Juneau Alaska
- Canfield, Harold T CE '13.....183 Harbard Ave Boston Mass
Asst Constr Engr Chas H Tenney & Co
- Cannon, Clayton P CE '10.....2618 Calvert St Baltimore Md
Constr Mgr B F Bennett Bldg Co 123 So Howard St
- *de la Cantera, Fernando CE '15 Bur of Insular Affairs Wash-
Prof Univ of Philippines Manila P I [ington D C
- *Capen, Charles H Jr CE '17-30 Whittlesey Ave E Orange N J
Asst San Engr State Dept Health Trenton N J
- *Carey, Matthew L CE '15.....JASCE YMCA Greenwich Conn
Statistician U S Rubber Co 1790 Broadway N Y C
- *Carlin, Joseph P BS CE '97 MASCE 270 Wash Ave Bklyn N Y
Pres P J Carlin Constr Co 1123 Broadway N Y C
- Carpenter, Clarence C CE '17.....R F D 6 Sidney O
Bridge Foreman MacArthur Bros Co R F D 5 Johnstown Pa
- *Carpenter, Frederick W CE '84 MASCE Box 307 Newburgh N Y
Cons Engr Bridge Comm Public Bldg Wilmington Del
- Carson, Richard B CE '14.....Woodlawn Inn Pittsfield Mass
- Carwell, David W CE '12.....121 St Marks Ave Brooklyn N Y
- *Cartwright, Frank P CE '15.....East Bloomfield N Y
Staff mem Roch Bur Mun Res 25 E Main St Rochester N Y
- Case, George W BS MCE '12 AMASCE MESWPa 3142 Avalon
Prof San and Hydr Engrg Univ of Pgh Pittsburgh Pa [St
Castillo y Grau, Antonio CE '10.....AMASCE MCuSE Cienfuegos
Engr Board of Health & Cons Engr Box 1669 [Cuba
- deCastro, Anastacio F CE '21.....1136 Singalong Manila P I
- Caves, Stuart S CE '16.....Phelps N Y
Superintendent Lumber Yard
- Cesario, Frank CE '16.....c/o Antonio Cesario Port Chester N Y
- Chadeayne, Henry F CE '18.....Firthliffe N Y
Treas & Asst Mgr Allied Industries Cornwall N Y
- Chaffee, Sidney L PhB BS in CE CE '09.....RD 13 Chalmers Ind
General Manager Farming
- Chamberlain, Jos J Jr CE '11 AMASCE 1723 Grand Ave Day-
Chief Engr Danis-Hunt Constr Co 908 Schwind Bldg [ton O
Chan, Iu-Choo CE '18.....MChES 63 Fung Yuen Tai St Canton
[China
- *Chandler, Albert H CE '02.....361 Gates Ave Brooklyn N Y
Asst Engr Queens Borough Coast Square Long Island City NY
- Chandler, Edward A CE '17.....23 School St Gardner Mass
Asst Engr Maint Way St Louis Div Big 4 R R
- Chang, Chen-Hsi MCE '21 MCES 3 Ehr-Chin-Lee Tientsin China
- *Char, Kwang Yi CE '12.....7 Jessfield Road Shanghai China
Banking
- Chase, Clement E CE '10.....AMASCE JASTM 52 Brookside Dr
Asst Engr R Modjeski 101 Park Ave N Y C [Larchmont N Y
Prin Asst Engr Bd of Engrs Delaware River Br Phila Pa
- Chase, George A Jr CE '14.....2003 Longwood St Baltimore Md
Supt Claim Dept Home Friendly Ins Co
- Chase, Richard W CE '05.....109 Madison Ave Holyoke Mass
With Merrill Oldham & Co Bankers of Boston
- Chavanne, John J Jr CE '21.....3969 Syosset St Woodhaven N Y
- Chen, Cheng S CE '17.....7 Gin Erh Hutung Lin Chin Kon
Instructor College of Communications Peking China
- Chen, Mao K CE '12.....Lwai-Kiang Foochow China
Asst Engr River Improvement Comm Tientsin China
- Chen, Poo Wha CE '15 Phd '17.....Yungting Fukien China
- *Child, John T CE '12 AMASCE 1940 Oxford St Rochester NY
San Engr Bur Mun Res 25 Main St
- Chirlian, Gustave CE '21.....913 Longwood Ave New York City
- Chiu, Hsieh Chun MCE '18.....MChES MSSCh Chung-Jen
McClintic-Marshall Constr Co [Chenghsien Chekiang China
Pittsburgh Pa
- *Cho, Wen-Yueh CE '16.....547 W 123d St New York City
Draftsman Dept Structures N Y C R R Grand Cent Term
- Chobot, Edwin F CE '21.....129 Dean St Brooklyn N Y
Instr School of Civil Engrg Ithaca N Y
- Christensen, Eiler M CE '21.....Norwich N Y
- Christian, Joseph H CE '20.....Millville Pa
McClintic-Marshall Constr Co 158 Arlington St Niles O
- *Christie, J G Carlisle CE '14.....MAWWA Durham N C
Associated with G C White Engineers
- Chuck, Hong-Sun AB CE '12.....AMASCE Tayeh Hupeh China
Manager Pacific Trading Co Laidlaw Bldg Hankow China
- *Chuckrow, Charles M CE '11.....544 W 145th St N Y C
Chief Estimator Fred T Ley & Co Inc 19 W 44th St
- *Church, Irving P CE '73 MCE '78 AASCE 7 South Ave Ithaca
Prof Applied Mechanics and Hydraulics Emeritus [N Y
Cornell Univ
- *Churchill, John P BS CE '01 MASCE 19 Whittelsey Ave E Or-
Chief Engr Hay Foundry and Iron Works Co [ange N J
Newark N J
- Cianchini, Louis F CE '16.....Coamo P R
First Lieut U S A San Antonio Tex
- Clapp, Robert V CE '20.....4403 St Clair Ave Cleveland O
- Clark, Arthur E CE '02 MASCE 7 Colden Ave White Plains N Y
Asst Div Engr Transit Constr Comm 441 E Tremont Ave NYC
- Clark, Charles CE '09.....Nichols N Y
Kansas City Structural Steel Co Kansas City Kans
- *Clark, Charles H CE '92.....MASCE MAREA 1716 E 81st St
Engr M of W Cleveland Ry Co Cleveland O
- *Clark, Lester P CE '17.....6024 Chabot Road Oakland Calif
Engineer for Standard Oil Co
- Clark, Otho M CE '14.....1330 Cherokee Road Louisville Ky
Sales Mgr Kosmos Port Cement Co 614 Marion Taylor Bldg
- *Clark, Robert W CE '09.....11 Woodlawn Terr Waterbury Conn
Pres and Gen Mgr Clark Constr Co 168 Grand St
- *Clark, Thomas S CE '94 MASCE 1436 E 17th St Brooklyn N Y
Treas & Chief Engr Alphons Custodis Chimney Constr Co
Bennett Bldg N Y C
- *Clark, William D CE '15.....Sidney N Y
Domestic Coke Corp Fairmount W Va
- *Clausz, Irving C CE '12 MAAE 1484 Westwood Ave Lakewood
Asst Engr Cleveland Union Term Co Cleveland O [Ohio
- Clawans, Edward CE '17.....32 Rutgers St Newark N J
- Clay, Leon G CE '20.....4132 St Charles Ave New Orleans La
With Gilbert & Clay Cotton Futures & Exporting
- *deClerq, Clarence F CE '07 MAAE 5 Hotchkiss St Binghamton
Asst Engr N Y State Hwy Comm 905 Press Bldg [N Y
- *Cleveland, Lou B CE '07.....261 Ten Eyck St Watertown N Y
- Clift, William B CE '11.....Omaha Neb
Vice President Omaha Trust Co
- *Clunan, Albert Jr CE '12.....693 Flatbush Ave Brooklyn N Y
Pureh Agent J G White Engrg Corp 43 Exch Pl N Y C
- *Cochran, Jerome BS CE MCE '07 1518 Hamilton St Houston
General Contractor First National Bank Bldg [Tex
Cochran, Thomas F CE '20.....257 Renshaw Ave E Orange N J
Produce Comm Merchant 290 Washington St N Y C
- Cockroft, Donald G CE '21.....Northport N Y
N Y Telephone Co 24 Walker St N Y C
- Codas, Alfredo B AB CE '12 MAAE Azara 56 Asuncion Para-
[guay
- *Coe, Ira J CE '94.....MAIMME 67 Santa Clara Ave Oakland
Cons Engr 762 Mills Bldg San Francisco Calif [Calif
- *Coffey, Philip T CE '14.....229 Newton Ave Astoria L I N Y
Capt 6th U S Engrs Camp Pike Ark
- *Cohen, Abraham CE '11.....2109 Pitkin Ave Brooklyn N Y
- Cohen, Morris G CE '19.....R F D Box 66 Monticello N Y
Draftsman N Y & N J Bridge & Tunnel Comm N Y C
- *Cohen, Paul CE '15.....569 W 150th St New York City
With Seelye & Fraser Cons Engrs 101 Park Ave
- Cohen, Samuel CE '09.....1082 President St Brooklyn N Y
Designer Wilputte Coke Oven Corp New York City
- Coit, Charles W CE '00.....Whatecom Wash
Inspector Concrete Road Constr Whatecom Co
- *Collett, Walter J CE '15.....1061 E 19th St Brooklyn N Y
1st Lieut U S A Coast Art Fort Samesamesa Honolulu T H
- Collins, A Smart CE '18.....717 Lafayette Ave Buffalo N Y
With Lackawanna Bridge Co
- *Collins, Charles W CE '89.....Greenwich N Y
Special Track Work Engr Lorain Steel Co Johnstown Pa
- Collum, Thad L CE '21.....702 S 15th St Corsicana Tex
Instr School of Civil Engrg Ithaca N Y
- *Colnon, Redmond S CE '87 AMASCE 408 Olive St St Louis Mo
Fruin & Colnon General Contractors 615 Laclede Bldg
- *Colsten, Albert L CE '95.....AASCE MASTM Brooklyn N Y
Consulting Engineer 1556 73d St

- *Coltman, Robert Jr CE '06 2436 First Ave Vancouver B C
Off Engr Glenville A Collins Engrs Ltd 409 Credit
Foncier Bldg [Can]
- *Comstock, Charles W CE Met E MCE '94 PhD '98--MASCE
Cons Engr First National Bank Bldg [76 Grant St
Denver Colo]
- *Conant, Frederic W CE '14 MAAE 14 E Valerio St Santa Bar-
captain U S A 3rd Engrs Schofield Barracks T H [bara Calif
- *Concepcion, Manuel S CE '14-----562 Legadra St Manila P I
Vice-President Philippine National Bank
- *Condon, John Jr CE '08-----1713 Sausonn St Philadelphia Pa
Cont Mgr Turner Constr Co 244 Madison Ave New York City
- *Conger, Alger A CE '97 MASCE 13 St Elmo Road Worcester
Hyd Engr New England Power Co 35 Harvard St [Mass
- *Conger, Hiram G CE '09-----Nntley N J
Clergyman 740 Rush St Chicago Ill
- *Conger, Jay Jr CE '16-----Groton N Y
With Groton Bridge Works
- *Conger, Laurence J CE '07-----Groton N Y
Sales Manager Corona Typewriter Co Inc
- *Conger, Walter C CE '12-----4706 Swiss Ave Dallas Tex
Mgr Highway Dept Truscon Steel Co Youngstown O
- *Conklin, William E CE '00-----MECNYC Beacon N Y
Gen Mgr So Dutchess Gas & Elec Co and Fishkill Elec Ry Co
Fishkill N Y
- *Conkling, Leon D CE '00 MASCE MSPEE 516 So Grand Ave
Prof Civil Engrg Mont State Coll Bozeman Mont
- *Conley, James CE '10-----308 E Seneca St Ithaca N Y
Highway Contractor
- *Connor, Frederick T CE '04-----133 Dempster St Evanston Ill
Dist Sales Agt Carbon Steel Co 819 Ry Exch Bldg Chicago Ill
- *Conover, G Elliot CE '21-----Asbury Park N J
- *Constans, Frank S CE '19-----5485 Cornell Ave Chicago Ill
Engrg Dept Ill Cent Ry Co
- *Conway, Herbert H CE '11-----Maplewood N J
Branch Mgr Hedricks Constr Co of N Y C Houston Tex
- *Conwell, Walter L CE '11-----969 E State St Ithaca N Y
Asst Prof Hwy Engrg School of Civil Engrg Cornell Univ
- *Cook, James R CE '20 Riverview Place Hastings-on-Hudson NY
Draftsman Hazen Whipple & Fuller 30 E 42d St N Y C
- *Cooman, Carl C CE '15-----AMASCE W Webster N Y
- *Coons, Paul D CE '05-----Riverside Ill
Asst Val Engr C B & Q R R 547 W Jackson Blvd Chicago Ill
- *Cooper, James A Jr CE '16-----426 56th St Brooklyn N Y
Struct Designer Seelye & Fraser Cons Engrs 101 Park Ave
N Y C
- *Corbet, Clinton I CE '15-----5638 Blackstone Ave Chicago Ill
- *Corbin, Horace CE '05-----234 Pelton Ave Staten Island N Y
Asst Engr Pier 6 E River New York City
- *Cormack, Charles M CE '20-----395 Jersey St Buffalo N Y
- *Cornell, W Rodney BS CE '15--MSPEE 438 No Aurora St
Asst Prof in Applied Mech Sibley School [Ithaca N Y
of Mech Engrg Cornell Univ
- *Cortina, Cesar CE '21-----S P Macoris Santo Domingo
- *Corwin, Daniel C CE '08-----AMASCE Valley Stream N Y
- *Cory, Harry T BEE BCE MCE '93 MME --MASCE MASME
Cons Engr U S Reclamation Service c/o USGS Wash D C
- *Cosgrove, Thomas Jr CE '09-----447 Second St Braddock Pa
- *da Costa, Oscar M CE '16 Rua D Marianna 213 Rio de Janeiro
Engr M of W N W Brazil Railway Bauru Sao Paulo [Brazil
- *Courtney, John H CE '17-----218 Eddy St Ithaca N Y
- *Covert, Pitt Jr CE '13-----366 C Y Ave Casper Wy
Oil Refining
- *Cowan, Lewis A BCE CE '05--Blackmore Apts Bozeman Mont
Civil Engineer Construction Northern Pacific Ry
- *Cownie, Donald L CE '17-----40 Bidwell Parkway Buffalo N Y
- *Cox, Homer F CE '97 MESNEPA MAWWA 430 Colfax Ave
Supt & Chief Engr Scranton Gas & Water Co Scranton Pa
- *Cozzens, Arthur B CE '13 MAICP MASMI 255 E 28th St Bkln
Assistant Manager Factory Products Corp 2 Rector St [N Y
N Y C
- *Craig, Dan S BS CE '13 MIOES 1169 21st St Des Moines Ia
Secy-Treas Empire Constr Co 203 Flynn Bldg
- *Craig, Joseph E BS CE '03 AMASCE 1449 Third Ave Columbus
[Ga]
- *Crandall, Carl CE '12-----AMASCE 404 Univ Ave Ithaca N Y
Asst Prof Rwy Engrg School of Civil Engrg Cornell Univ
- *Crandall, Lynn CE '10-----AMASCE 316 Hector St Ithaca N Y
Water Commissioner for Big Lost River Mackay Idaho
- *Crane, Albert S CE '91-----MASCE MBosSCE
Vice-Pres J G White Engrg Corp 43 Exchg Place N Y C
- *Crane, Frederick W CE '19-----60 Tennyson Ave Buffalo N Y
Design & Est Dept Lackawanna Bridge Co
- *Crichtlow, Howard T CE '10-----AMASCE 577 Rutherford Ave
Water Engr Dept of Conser & Development State House
Trenton N J
- *Crofts, Edgar R CE '10-----Hanover Conn
Designing Engr Roch Gas & Elec Co Rochester N Y
- *Crook, C Earl CE '16-----317 So Penn St Wheeling W Va
Structural Engineer J E Moss Iron Works
- *Crossette, Murray F CE '02-----MAIMME 1136 Emerson St
Cons Engr 507 First Nat Bank Bldg Denver Colo
- *Crossman, Ralph S CE '11-----MIES Huntington N Y
Prof Civil Engrg Des Moines Coll Des Moines Ia
- *Crouch, N Seymour CE '90-----127 W 11 St Erie Pa
Cashier Shepherd Engrg Co
- *Cudebec, Albert B CE '08-----MASCE Paris France
European Mgr Ohio Brass Co 7 rue de Tilsitt
- *Cuff, James E CE '12-----AMASCE YMCA Rochester N Y
Lawyer Roehr Savings Bank Bldg
- *Culbertson, William J CE '15-----211 Sheriff St Paris Ill
Constr Dept Holly Sugar Corp Boston Bldg Denver Colo
- *Cummin, Gaylord C CE '04--AMASCE MAWWA 31 Bellevue
Cons Engr Inst for Pub Service 51 Chambers [Ave Dayton O
St N Y C
- *Cummin, Hart CE '09--AMASCE 31 Bellevue Ave Dayton O
719 Am Bk Bldg Kansas City Mo
- *Cummings, Edward CE '17--2877 Briggs Ave New York City
Ward Motor Vehicle Co Mount Vernon N Y
- *Cumings, Elmore D CE '80--MASCE 4608 15th St N W
U S Asst Engr off Chief of Engrs 20th & B Sts Wash D C
- *Cummings, Noah CE '94--AMASCE 457 Dunham Ave Mt Ver-
Asst Engineer Dept Plant and Structures [non N Y
Municipal Bldg N Y C
- *Curry, Albert CE '02-----Woodland Road Pittsburgh Pa
Real Estate, 1507 First National Bank Bldg
- *Curry, Lynn B CE '13--MAAE Box 153 Meeklenburg N Y
Civil Engr with Gannett Seelye & Fleming Harrisburg Pa
- *Curtis, Charles E CE '85--MASCE 111 Quarry St Ithaca N Y
Supt Bldgs and Grounds Cornell Univ
- *Curtis, Charles W CE '88 LLB--17 Melrose St Rochester N Y
Statistician Sill Stove Works 524 Oak St
- *Curtis, George D BS CE '09--AMASCE 316 Cass St Tampa
Cashier of The Morris Plan Bank of Tampa [Fla
- *Curtis, Gram CE '72--323 No Jefferson St New Castle Pa
Mech Engr & Desnr New Castle Works Carnegie Steel Co
- *Curtiss, R Elmer CE '04--41 Sumner St Hartford Conn
Contractor and Civil Engineer 721 Main St
- *Custer, Lewis B CE '07--57 North St Mt Vernon N Y
Bond Dept Guaranty Trust Co 140 Broadway N Y C
- *Dalmen, Ernest A CE '06--113 Ferris Place Ithaca N Y
County Asst Engr Tompkins Co N Y State Highway Comm
- *Dailey, Bernard C CE '17--600 W 192d St New York City
First Lieut C A C Fort Mills Manila P I
- *Daley, DeWitt H CE '06--Chatham N Y
Sen Asst Engr N Y State Barge Canal Off Lyon Block Albany
- *Dalton, Douglas A CE '14--Riverside Conn
- *Daly, John W CE '12 AMASCE 238 Mayflower Ave New Ro-
Assistant Engineer Transit Constr Comm [chelle N Y
Brooklyn N Y
- *Daly, Walter P CE '16--612 Washington St Olean N Y
Engineer 1212 Otis Bldg Philadelphia Pa
- *Danforth, Thomas F CE '15--364 Norwood Ave Buffalo N Y
John W Danforth Co 70-72 Elliott St
- *Daniels, Percy N CE '15--602 Stuyvesant Ave Trenton N J
Sanitary Engineer State Dept of Health
- *Danis, Benjamin G CE '09--930 Chester Ave Dayton O
Pres the Danis-Hunt Constr Co Genl Contrs 908 Schwind Bldg
- *Dann, Alexander W CE '07--AMASCE Sycamore St Haysville
Vice-Pres & Treas Keystone Sand & Supply Co [Pa
Pittsburgh Pa
- *Darrow, Henry D CE '07--153 Pearl St Kingston N Y
Assistant Engr N Y State Highway Comm Div No 1
- *Darrow, Marius S CE '99--AMASCE Kingston N Y
Manager Barber Asphalt Paving Co Madison Ill
- *Darrow, Warren E CE '07--118 Boyce Ave Utica N Y
1502 Crittenden St Washington D C
- *Darrow, Wilton J CE '99--MASCE Lakewood N Y
Oceanside Calif
- *Darville, Merton A CE '12--162 25th St Elmhurst N Y
Off Mgr Constr Dept Turner Constr Co 244 Madison Ave NYC
- *Daudt, Ralph B AB '07 CE '10--AMASCE MTSE 2629 Robin-
Chief Engineer A Bentley & Sons Co Toledo O [wood Ave
Davenport, Ward P CE '93--40 Church St Plymouth Pa
Supt Spring Brook Water Supply Co 114 W Main St
- *Davidson, Clarence H CE '11 84 Monmouth St Springfield Mass
Designing Engineer Bureau Public Works Manila P I
- *Davis, Carl E CE '91--MemECI 1369 Madison Ave Memphis
Hydr Engr Memp Artesian Water Dept [Tenn
- *Davis, Charles S CE '89 MAREA MASCE 306 Broad St Scwick-
Cons Engr 802 Century Bldg Pittsburgh Pa [ley, Pa
- *Davis, Donald G CE '17--8 Noyes St Utica N Y
Asst Supvr E I du Pont Co Penns Grove N J
- *Davis, E Russell CE '13--MASMI 310 55th St

- Chief Civil Engr 2613 Huntington Ave Newport News Va
 Davis, George J Jr CE '02 AMASCE Pinchurst Tuscaloosa Ala
 Dean & Professor Civil Engrg University of Ala
 Davis, John C CE '00-----AMASCE Milwaukee Wis
 Simmons & Davis Cons Engrs 811 Majestic Bldg
 Davis, Lynn L CE '96--MASCE 32 University Ave Buffalo N Y
 Prin Asst Engr U S Army Engrs Off 540 Federal Bldg
 Davis, Meyer CE '08-----MASCE 152 W 118 St N Y C
 Contractor & Builder 55 Liberty St
 Davis, R Menees CE '07-----AMEL 36 Queens Rd Queens N Y
 Statistical Editor *Electrical World* New York City
 Davis, Roland P SB MCE '08 PhD '14 MAREA MASCE Mor-
 Prof Str & Hyd Engrg W Va Univ & Cons [gantown W Va
 Br Engr State Rd Comm
 Dawson, Francis M BS in CE MCE '13 AMEIC MASTM Truro
 Acting Asst Prof Hydraulics School of [Nova Scotia
 Civil Engineering Cornell Univ Ithaca N Y
 Day, Harold CE '20-----Mexico N Y
 67 No Franklin St Pottstown Pa
 *Day, Warren E CE '10-----Oakdale Stanislaus Co Calif
 Res Engr Phoenix Utility Co Neshqueboning Pa
 Deagon, Arthur CE '21-----190 Randall Ave Freeport N Y
 Dean, George W BS CE '04-----Griswold Ia
 *DeCarre, Octave CE '11-----3522 13th St N W Washington D C
 Major U S A C A C
 Decker, A Clinton CE '09--MAPubHA MAWWA 759 Parkway
 San Engr Tenn Coal Iron & R R Co [Fairfield Ala
 Birmingham Ala
 *DeGarmo, Robert M CE '09 MAAE AMASCE Cocoonut Grove
 Asst Engr F E C RR St Augustine Fla [Fla
 Degling, Albert O CE '20-----173 N 15th St E Orange N J
 Asst Engr Cuba Central Ry Sagua la Grande Cuba
 *DeGolyer, Calvin S CE '10-----Table Rock Farm Castile N Y
 Farmer
 *Dehuff, Wilmer A CE '10-----203 E 32 St Baltimore Md
 Associate Professor Johns Hopkins Univ
 *DeLano, Harry C CE '95-----MASCE Canastota N Y
 Delany, Lewis H CE '12-----JASCE Flint Mich
 *Demarest, John McL CE '14--584 W 152d St New York City
 Deaneff, Robert C CE '04--AMASCE 40 Third Pl Brooklyn N Y
 Off Engr Nat Board Fire Underwriters 76 William St N Y C
 Dennis, Harry W CE '99-----MASCE 871 No Kenmore Ave
 Constr Engr So Cal Edison Co Edison Bldg Los Angeles Cal
 Dennis, Olive W CE '20-----1021 Madison Ave Baltimore Md
 Drafts Bridge Engrg Dept B & O RR
 Denniston, Jesse H CE '09-----Cornwall N Y
 Engr Storm King Hwy N Y State Hwy Dept
 *Devin, George CE '73-----MASCE Los Angeles Calif
 Bridge Engr St L & S F R R 626 Frisco Bldg St Louis Mo
 *DeWitt, John CE '17-----Broadmore Colorado Springs Colo
 *Diamant, Albert CE '09-----AMASCE Pine Hill N Y
 Constr Engr Chile Exploration Co Tocopilla Chile
 Dickens, Wayland CE '09-----Alpine N Y
 Asst Engr N Y C Board of Water Supply Gilboa N Y
 *Dickinson, J Haines CE '90-----Montclair N J
 Mgr & Chf Engr Logging Dept Lidgerwood Mfg Co 96
 Liberty St N Y C
 *Dickinson, William E CE '14-----
 313 Federal Bldg Salt Lake City Utah
 Diefendorf, Charles W CE '08--203 W Borden Ave Syracuse NY
 Dillard, William R CE '17-----302 E Main St Washington Ga
 Engr Converse Bridge & Steel Co Chattanooga Tenn
 *Dillenbeck, Arvin J CE '11-----AMASCE 50 Wellington Rd
 Contracting 594 Ellicott Sq Buffalo N Y
 *Dillenbeck, Clark CE '88 MASCE MECIPH 123 W Upsal St
 Asst Chief Engr P & R Ry Co Reading [Germantown Pa
 Term Philadelphia Pa
 Dimjian, Aran H CE '18-----Ithaca N Y
 Res Engr for Wm C Spiker 749 No Boulevard Atlanta Ga
 *Dimon, Daniel Y CE '96-----MASCE Riverhead N Y
 Power Specialty Co 111 Broadway New York City
 *Dingle, James H BA CE '92-----MASCE 182 Tradd St
 City Engineer Charleston S C
 *Dinnerstein, Nathan CE '17--1911a Atlantic Ave Brooklyn N Y
 Distler, Walter G CE '13-----2905 No Calvert St Baltimore Md
 Baltimore Manager Geo A Fuller Co American Bldg
 Dittmar, Albert L CE '19-----916 Erie Ave Williamsport Pa
 State Hwy Inspector 224 No Broad St Jersey Shore Pa
 *Ditttrich, John A CE '14-----2555 Grand Concourse N Y C
 Sales Engr Blaw-Knox Co 165 Broadway
 *Dixon, DeForest H CE '96 AMASCE East Shore Rd Great
 Vice Pres Turner Constr Co 244 Madison Ave NYC [Neck LI
 *Dockstader, Simeon E CE '10-----No Tonawanda N Y
 Superintendent Engineer American District Steam Co
 *Dodge, J Lynn CE '94 MAAE MASCE 253 Lake Ave Pitman
 Plant Engr U S Ship Bldg Emergency Fleet Corp [N J
 Hog Island Pa
 *Dodgson, Frank L CE '89-----MAREA Rochester N Y
 Consulting Engineer General Railway Signal Co
 Dodson, Richard S BS CE '08 c/o Adj Gen of Army Washing-
 Lt Col 303d FA Manila P I [ton D C
 *Doebler, Errol W CE '15-----Box 611 Sea Cliff N Y
 Desng Draftsman Hazen Whipple & Fuller 30 E 42d St NYC
 Dole, Walter S CE '92 MAGAsI 1223 5th St Santa Monica Calif
 Dominguez, Rafael CE '04-----MASCE Rio de Janeiro Brazil
 e/o Anglo Mexican Petroleum Co Ltd Box 252
 Donnellan, George P CE '10--10 Stratford Park Rochester N Y
 Engr Brazos River Oil Corp 520 1/2 Spring St Shreveport La
 Doores, William R CE '93-----
 Col U S A Coast Art Fort Totten N Y
 Dornbach, Earle E R CE '15 108 W Main St Mechanicsburg Pa
 Dorsey, John G CE '16-----1059 Washington St Detroit Mich
 Dougherty, Nathan W BS in CE CE '13 MCE '14--AMASCE
 Head Professor Civil Engrg Univ of Tenn [MSPEE MAAAS
 Knoxville Tenn
 Douglas, Damon G CE '21-----Park Ave Mount Vernon N Y
 Turner Constr Co 244 Madison Ave New York City
 Douglas, P Gordon CE '06-----Hamadan Persia
 Imperial Bank of Persia
 Dow, Hezekiah S CE '15-----JASCE 312 Lee St Evanston Ill
 Field Engr Chicago Union Station Co Chicago Ill
 *Dowling, Joseph L CE '89-----Box 1805 Houston Texas
 Vice-President The Texas Pipeline Co
 *Downey, Archibald S CE '96 MASCE MPNWSE 906 Summit
 Civil Eng & Contractor 310 Hoge Bldg Seattle Wash [Ave
 Doyle, Robert E CE '12-----916 Park Ave Richmond Va
 Supt Geo A Fuller Co 402 Sweetland Bldg Cleveland Ohio
 Drake, Archibald E CE '07--490 Huron Ave Cambridge Mass
 Supr N E Travelers Ins Co 141 Milk St Boston Mass
 *Dransfield, Thomas Jr AB CE '10--12 Russell St Malden Mass
 Engr Str Dept Stone & Webster Inc 147 Milk St Boston Mass
 Drennen, Everett CE '08 MAIME MNatCoalAssn MRRCl of NY
 President W Va Coal & Coke Co Elkins W Va
 *Driscoll, James F CE '17-----105 College Ave Ithaca N Y
 c/o Concrete Steel Co 524 Guardian Bldg Cleveland O
 *Duba, John Jr CE '15--MAAE 17 Stratford Apts Norfolk Va
 Asst Contr Mgr Public Works Off Navy Yd
 *Dubuis, John BA CE '09-----AMASCE 3045 Johnson St
 Asst Prof Civil Engrg Oregon State College Corvallis Ore
 Ducasse, Vidal CE '20-----8 Carlos III Havana Cuba
 Duckham, Albert E CE '90-----MESWPa 246 So Rebecca St
 Cons Civil Engr 413 House Bldg Pittsburgh Pa
 Duffies, Edward J CE '88--MAAE MASCE Washington D C
 U S Asst Engr Rivers & Harbors Div Off Chief of Engrs
 War Dept
 Duffies, Edward L CE '21--2412 12th St NE Washington D C
 Dunean, Daniel T CE '18-----Ninety Six S C
 Ensign U S N R F U S S Henderson
 Dunham, Walter H CE '94-----187 Maryland St Buffalo N Y
 Chief Engr C F Ernsts Sons Iron Works 75 Lathrop St
 Dunlap, Arthur H BS of CE CE '99--AMASCE Barstow Texas
 Cons Engr Ward Co Irrig Dist 2
 *Dunn, Albert C CE '14-----1725 Park Ave Richmond Va
 Highway Engr Bur Pub Roads Box 415
 Dunn, Frank S CE '92-----MAGAsA MSEENY Albany N Y
 Supt Gas Dept Mun Gas Co 124 State St
 *DuPré, Wallace D AB AM CE '13-----233 N Church St
 Manager Ford Agency Spartanburg S C
 *Durkan, William J CE '06--158 Flower Ave E Watertown N Y
 *Duryea, Edwin Jr CE '83 MASCE 318 Lincoln Ave Palo Alto
 Civil & Cons Engr 1318 Humboldt Bank Bldg San [Calif
 Francisco Calif
 *Duschak, Ernest A CE '06--231 Durand St Sarnia Ont Can
 Engineering Department Imperial Oil Co
 Dyson, James CE '78--MAIME 1437 Reese St Silverton Colo
 Civil and Mining Engineer U S Mineral Surveyor
 Earl, Mark A BS MCE '94-----Muskogee Okla
 Consulting Engineer
 Eddy, Allerton CE '21-----Canaan Conn
 Eddy, Henry T CE '70 AB PhD '72 MAPhS FAAAS 916 S E
 6th St Professor and Dean Emeritus Univ of Minn Minne-
 apolis Minn
 *Edge, Alfred J CE '06-----c/o W S Edge Westfield N J
 Asst Mgr U S Rubber Pltn Medan Sumatra D E I
 *Edge, Walter S CE '03 MACI 122 N Euclid Ave Westfield N J
 Chief Engineer Concrete Steel Co Broadway N Y C
 *Edmunds, Robert C CE '18-----617 E 16th Ave Denver Colo
 Goodrich Rubber Co Akron O
 Edwards, Elmer G CE '12 3341 Bryant Ave S Minneapolis Minn
 Hwy Engr U S Bur Pub Rds 410 Hamm Bldg St Paul Minn
 *Edwards, James H CE '88-----MASCE Passaic N J
 Asst Chief Eng American Bridge Co 30 Church St N Y C
 *Edwards, Latta V BE CE '11-----MAAE
 Cons Engr Winston-Salem N C

- Edwards, Mewellyn H CE '15.....Dryden N Y
Chief of Corps M W Dept Erie RR Meadville Pa
- Edwards, Robert F CE '17.....480 Mansfield Pl Brooklyn N Y
Assistant Engineer U S Geol Survey Helena Mont
- *Egbert, J Byron CE '07.....363 Smith St Peekskill N Y
Co Asst Engr N Y State Hwy Comm Westchester Co
- *Egeberg, Hans O CE '00.....712 Jackson St Gary Ind
Supt Labor Illinois Steel Co Gary Works
- *Ehle, Boyd CE '86.....MASCE East Creek N Y
- Ehlers, Joseph H MCE '16.....151 Seymour St Hartford Conn
Prof Structural Engrg Pei Yang Univ Tientsin China
- Ehlers, Victor M BS CE '10 TexWWA MAPubHA LaGrange
State San Engr Capitol Station Austin Tex [Tex
- *Ehrlich, Arthur C CE '14.....15 W 107th St New York City
Chief Engr American Tobacco Co 111 Fifth Ave
- *Eickelberg, Ernest W CE '13.....AMASCE 1215 Parkwood Dr
Hydro and Geod Engr USC&GS Washington DC [Cleveland O
- *Eidlitz, Otto M CE '81.....MASCE MASTM 489 Fifth Ave
Engineer & Builder 30 E 42d St New York City
- *Eilenberger, Charles F CE '16.....58 Grand Ave Middletown NY
- Eisenbrandt, Alexander S CE '20.....Ridge Rd Mt Washington
[Baltimore Md
- Eisenbrandt, Frederick H CE '18 Ridge Rd Mt Washington
Assistant Engineer Dept of Sewers [Baltimore Md
- Eisner, Benjamin CE '20.....700 So Broad St Trenton N J
- *Elkind, Isadore J CE '13.....117 Saratoga Ave Yonkers N Y
Asst Manager S Blikman 199 Lafayette St N Y C
- *Elliott, John E AB CE '05.....MECIT 1530 Riverside Ave
Plant Engr Trenton Plant Am Bridge Co Trenton N J
- Ellis, Albert R CE '05.....6339 Marchand St Pittsburgh Pa
- Ellis, Douglas MCE '20.....209 Albert St Kingston Ont Can
- *Ellis, Guernsey W CE '04.....MAAE 3 Olive Pl Hornell N Y
Asst Engr N Y State Highway Department
- *Ellis, Lawrence R CE '04.....5230 21st St NE Seattle Wash
Secretary Rogers Mylroie Lumber Co
- *Ellsworth, Goodwin D Jr CE '10 1248 Girard St NW Wash DC
G D Ellsworth Co Contrg Engrs 412 U S Nat Bank Bldg
Portland Ore
- *Elting, Oscar R CE '14.....AMASCE New Paltz N Y
Asst Engr Bureau of Water Supply Akron O
- *Elton, Richard L CE '12 AMASCE 3330 Tracy Ave Kan City
Manager Builders Material Supply 309 Republic Bldg [Mo
- *Elwood, Frank E CE '06.....Gouverneur N Y
Business Taber Alberta Can
- *Ely, G Wells CE MCE '11.....190 Wachworth Ave N Y C
- Emmert, Luther D CE '11.....1704 Hinman Ave Evanston Ill
Rep Buffalo Forge Co 562 W Washington Blvd Chicago Ill
- *Engel, Arthur W CE '09.....333 Thorn St Sewickley Pa
Str Designer Am Br Co 1420 Frick Bldg Pittsburgh Pa
- Engel, Joseph S CE '20.....615 Quincey St Brooklyn N Y
- *Engle, Francis J CE '10 MAAE 2000 32d Ave So Seattle Wash
Asst Engr Great Northern Ry Rm 310 King St Sta
- *Eppleur, Charles Jr CE '17.....266 E 162d St New York City
Salesman Export Dept Consolidated Steel Corp 25 Broadway
- *Erickson, Charles E CE '10.....1616 East Howell St
Contracting & Lumber 317 Hage Bldg Annex Seattle Wash
- *Erisman, Henry L CE '92.....5433 Page Blvd St Louis Mo
R of W Appraiser St L & S F Ry Co 631 Frisco Bldg
- *Etnyre, Samuel L CE '88.....MIAES MAWWA 303 2nd St
Superintendent Water Works Co Council Bluffs Ia
- Evans, Edward A CE '06.....511 W 143d St New York City
Du Pont Engineering Co Gibbstown N J
- Evans, William H CE '15.....2321 West End Ave Nashville Tenn
Civil Engr Standard Oil Co of La 1206 Whitney Cent Bldg
N Orleans La
- *Eyrich, Harold R CE '14.....Phoenixville Pa
- Fahey, Aloysius A CE '14.....Eastport Me
- *Fahy, Charles H CE '17.....21 Arnold Park Rochester N Y
- Fairbanks, Herbert S CE '10.....2041 E 32d St Baltimore Md
Sen Hwy Engr Bur Pub Roads Dept of Agr Wash D C
- *Falkenau, Louis CE '73 MCE '77 6901 Candon Ave Chicago
Retired [Ill
- *Fancher, Archie J CE '11.....2203 Ditmar Ave Brooklyn N Y
Telephone Engineer N Y Tel Co 81 Willoughby St
- *Farlin, Charles D CE '13.....Glens Falls N Y
200 Edgewater St Rosebank N Y
- *Farmer, William F CE '76.....126 Amherst St Nashua N H
Retired
- Farr, Newton C CE '09.....4737 Woodlawn Ave Chicago Ill
Real Estate 140 So Dearborn St
- *Farrington, William S CE '88.....359 Norwood Ave Buffalo N Y
Pres & Treas General Flour & Feed Co 18 Letchworth St
- *Fassett, Newton C CE '04.....150 Lake St Elmira N Y
Elmira Rep Hemphill Noyes & Co of N Y C
- Faucher, Cyril A CE '10.....268 Alexander St Rochester N Y
Smt of Constr Turner Constr Co 244 Madison Ave N Y C
- Faustman, William F CE '07 MAAE 423 22d St Sacramento Cal
Asst Engr Calif State Hwy Comm 207 Calif Fruit Bldg
- Fay, Alfred L CE '20.....Longmeadow Mass
Draftsman Hool & Johnson Cons Engrs 445 Milwaukee St
Milwaukee Wis
- Fay, Arthur T CE '12.....Cooperstown N Y
Asst Constr Engr Semet-Solvay Co Buffalo N Y
- *Fear, Holbert W CE '13.....74 Prospect St Gloversville N Y
Member Firm Fear & White Glove Manufacturers
- *Feehan, Harry J CE '14.....807 E State St Ithaca N Y
Truseon Steel Co 58 Lafayette Blvd Detroit Mich
- *Fein, Paul CE '17.....159 Beach 45th St Edgemere N Y
Civil Engineer
- *Feiner, Mark A CE '13.....3143 Broadway New York City
With P Feiner 335 W 44th St
- *Feldman, Louis CE '16.....883 Longwood Ave N Y C
- Felknor, James M AB CE '09.....R D No 3 Morristown Tenn
Assistant Engineer Colusa Calif
- *Fellman, Morris CE '09.....140 W 69th St N Y C
Designer & Engineer S M I Engrg Co 15 E 40th St
- Ferguson, George A CE '01 628 Eleventh Ave No Seattle Wash
Pres Ferguson Constr Co 403 Securities Bldg
- *Ferguson, Oscar W CE '75.....724 G St N E
Hydrographic & Geodetic Engr USC&GS Wash D C
- *Fernandez, Francisco J CE '17.....Box 518 Cienfuegos Cuba
- Fernow, Ross R CE '02.....16 Admiral Road Toronto Ont Can
Cons Engr 1524 Chestnut St Philadelphia Pa
- *Ferrer, Francisco J CE '17 Concejal Veiga 18 Vibora Havana
[Cuba
- Ferris, George F CE '81.....Sierra Madre Calif
- *Ferris, Ralph J CE '07.....
Asst Engr State Water Supply Comm of Pa Harrisburg Pa
- Fertel, Arthur CE '21.....303 Hooper St Brooklyn N Y
Asst Engr N Y State Hwy Comm Ithaca N Y
- *Field, Arthur M CE '14.....AMASCE 25 Argyle St
Hopkins & Field Cons Engrs 349 Cutler Bldg Rochester N Y
- *Fields, Frank V CE '18.....21 Serrell Ave Binghamton N Y
Lisle N Y
- Filby, Ellsworth L CE '17.....MAPubHA 1614 Senate St
State San Engr State Board of Health Columbia S C
- *Filkins, Claude W L CE '93 MCE '94.....1701 Madison Ave
Civil Engr & Contr 725-6 Commercial Trust [Scranton Pa
Bldg Philadelphia Pa
- Finch, Burtis J CE '07.....MAAE 416 28 St Ogden Utah
Dist Eng U S Bur of Pub Rds Dist No 12
- Finch, Jerry C CE '02.....827 Lancaster St Albany N Y
Acting Secretary N Y State Highway Comm
- *Finkelburg, Elliot A CE '15.....R D 1 Missoula Mont
Chief Hydrographer Minidoka Irrigation Dist Rupert Ida
- *Finkelstein, Nathan R BS CE '11.....157 W 79th St N Y C
Sec & Treas Sam Finkelstein & Co 807 Broadway
- Finley, George I CE '00.....104 E End Ave Pittsburgh Pa
- *Firth, Elmer W CE '95 AM PhD AMASCE 1 John St Jamaica
Asst Engr in charge Maint Bur Sewers Bor of Queens N Y C
- *Fischer, Nemo M CE '12.....21st St Flushing L I N Y
Sales Manager Mulford Haas Co Brooklyn N Y
- *Fish, John C L CE '98.....MASCE MAREA 308 Lincoln Ave
Prof Railroad Engrg Stanford Univ Palo Alto Calif
- *Fisher, Clarence F CE '09.....367 E 149 St Cleveland O
Superintendent Lundoff-Bicknell Co
- Fisher, Frederick W CE '03.....MASCE MRoES Fairport N Y
Adjuster Employment & Safety Mgr Roch Gas & Elect Corp
- Fisher, Harold S CE '20.....499 Plymouth Ave Buffalo N Y
- Fisher, John E CE '18.....308 W Seneca St Ithaca N Y
- *Fisher, Wager CE '99.....AMASCE Bryn Mawr Pa
Cons Engr 815 Commonwealth Bldg Philadelphia Pa
- Fitch, Charles W CE '10.....c/o Southern Ry Washington D C
- Fitch, Squire E CE '00 MASCE 42 Academy St Westfield N Y
Div Engr N Y State Hwy Dept Buffalo N Y
- Fitzgerald, James W CE '18.....James St Clayton N Y
Asst Cashier Nat Exchange Bank and Auditor for Village
- *Fitzgerald, John M CE '09.....MARYB&BA Fillmore N Y
Roadmaster Cent of Ga Ry Room 209 Term Sta Macon Ga
- *Fitzpatrick, Frank T CE '15.....432 W 51st St N Y C
Jun Asst N Y State Public Service Comm 1st Dist
- Fitzpatrick, Paul E CE '21.....2037 Seneca St Buffalo N Y
Building Construction
- *Fitz-Randolph, W S CE '05.....MAAAS Sloatsburg N Y
Prod Engr Ord Dept U S A Art Am & Expl Seal Bridgeport
Conn
- Flanigan, Horace C CE '12.....Quaker Ridge New Rochelle N Y
- Fleming, Thomas Jr BS CE '05.....MASCE 648 Maryland Ave
c/o Oil Well Supply Co Pittsburgh Pa
- *Fleming, Thomas J CE '13.....29 Beacon St Waterbury Conn
- *Flynn, Walter F J CE '12.....118 W 48th St New York City
- Foard, Arthur V CE '06 AMASCE 1602 Linden Ave Baltimore
Asst Supt Md Dredging & Contracting Co
- Follansbee, Robert CE '02.....MASCE Denver Colo
Dist Engr U S G S 403 P O Bldg
- Foot, Benjamin F AB '13 CE '16 831 Holland Ave Wilkins-

- e/o Pittsburgh-Des Moines Steel Co Pittsburgh Pa [burg Pa
 Ford, Robert G CE '07-----Bellwood Pa
 Supvr Williamsport Div Penn RR Look Haven Pa
 *Forrest, Geo M BS CE '02-----MASME 704 Paximosa Ave
 General Supt Ingersoll Rand Co Phillipsburg N J [Easton Pa
 Forster, Clarence E CE '15-----34 Willow Lawn Buffalo N Y
 Asst Engr Natl Aniline & Chem Co
 *Fort, Edwin J CE MCE '94-----MASCE MASTM MASMI
 City Manager Niagara Falls N Y
 *Fortier, Ernest C CE '18-----615 E Walnut St Pasadena Calif
 *Foster, Frank G CE '10-----12 St James St Newton Mass
 Engr Fred T Ley & Co Inc 19 W 44th St N Y C
 *Foster, Henry A BS CE '16-----205 Garfield Place So Orange NJ
 Parker Klapp Brinkerhoff & Douglas 84 Pine St N Y C
 *Foster, Thomas M CE '04-----5659 Rosemary Pl N Orleans La
 Asst Secy Louisiana Fire Prevention Bur 438 Baronne St
 *Foster, Willard S CE '19 JASCE 161 Ridge Road Rutherford
 Asst Engr Belding Paul Corticelli Ltd St Johns PQ Can [N J
 Fountain, Thomas L BS in CE '05-----MASCE College Sta Tex
 Res Engr Lookwood Greene & Co 145 Bloomfield Ave Passaic
 N J
 *Fowler, Charles H CE '14-----Little Falls N Y
 Truscon Steel Co 2541 Oliver Bldg Pittsburgh Pa
 *Fowler, George CE '14-----1568 E 18th St Brooklyn N Y
 Org & Choirmaster St Chrysostom's Chapel Trinity Parish
 N Y C
 Fox, A Manuel CE '11-----131 Saratoga Ave Yonkers N Y
 Engrg Asst Gen Val Counsel N Y C RR 3634 G C T N Y C
 Fox, Charles J CE '11-----Ellicottville N Y
 *Fox, Robert L CE '09-----AMASCE 126 State St Batavia N Y
 City Engineer Bethlehem Pa
 *Frank, Alfred CE '98-----MAIME Salt Lake City Utah
 Mining Engineer & President Mining Cos 625 Newhouse Bldg
 *Frank, George S CE '11-----AMASCE Laurel Hill N Y
 Constr Supt J G White Engrg Corp Kahuhu Oahu T H
 Frank, Harry H CE '12 AMASCE 753 Mellon St Pittsburgh Pa
 Dist Engr Cone Steel Co 971 Union Arcade
 Frank, Leslie C CE '13-----AMASCE MACHS Dallas Tex
 Assoe San Engr U S Pub Health Ser Municipal Bldg
 *Fraser, Edwin A CE '10 AMASCE 607 Rugby Rd Brooklyn NY
 Sales Engr 105 W 40th St N Y C
 Freeman, Herman M CE '93-----61 So Valley Road W Orange N J
 Assistant Town Engineer
 *Freeman, William B BCE CE '05 AMASCE Univ Club Denver
 Branch Manager Look Joint Pipe Co 500 Railroad Bldg [Col
 *French, James B CE '85 MASCE 75 Alsop St Jamaica N Y
 Consulting Engineer 50 Chmreh St New York City
 Freyre, Leopold E AB CE '10 MCUSE 12th St Vedado Havana C
 Civil Engr Central Cunagua Camaguey Cuba
 *Fried, Isador CE '10-----1024 Main St Bridgeport Conn
 *Friedenberg, Benjamin CE '17-----86 Amboy St Brooklyn N Y
 e/o Director Coast Surveys Manila P I
 Friese, Edwin CE '09-----Catonsville Md
 Res Engr State Rd Comm 601 Garrett Bldg Baltimore Md
 Fritz, Eduard Jr CE '20-----254 Main St Poughkeepsie N Y
 Fritz, William H Jr CE '16-----Berwyn Pa
 Lumber Business 1420 Chestnut St Philadelphia Pa
 Frosch, Albert E CE '09-----134 Stamm Ave Pittsburgh Pa
 Mem Firm Mish Netherland Inc Engrs & Contrs and J H
 Gilmore Inc Equip Co Room 2218 Oliver Bldg
 *Frost, Charles P CE '16-----253 Church St Poughkeepsie N Y
 With Carson Construction Co Gordon Ga
 Froto, Antonio E de M CE '77-----Ceara Brazil
 Professor of Mathematics
 Fruchtbau, Jacob CE '17-----771 Irving Ave Syracuse N Y
 Engrg Salesman Truscon Steel Co 440 Gurney Bldg
 *Fuehs, Abraham W CE '13-----520 Jerome St Brooklyn NY
 San Engr U S Pub Health Service Memphis Tenn
 *Fuehs, John Jacob CE '17-----334 E 17th St New York City
 Sales Engineer Cham of Comm Bldg New Haven Conn
 *Fuertes, James H CE '83-----MAIconsE MASCE
 Consulting Engineer 140 Nassau St New York City
 *Fuller, Almon H MCE '98-----MASCE 722 Douglas Ave
 Prof Civil Engrg Iowa State Coll Ames Ia
 *Fuller, Weston E CE '00-----MASCE MNEWWA
 Hazen Whipple & Fuller Cons Engrs 30 E 42d St N Y C
 *Fulton, Daniel F CE '03-----33 Morsemere Pl Yonkers N Y
 Office Manager Ingersoll Rand Co New York City
 *Fulton, William J CE '12-----Brady Mont
 Engineer State Highway Comm Great Falls Mont
 *Gaffin, William W CE '96-----MWeSE Fond du Lac Wis
 Gaffin & Gehri Engrs & Contrs 270 Sheboygan St
 Gage, Lloyd G CE '02-----1231 W Broadway Butte Mont
 Civil and Mining Engr Anaconda Copper Mining Co
 *Gallagher, Joseph CE '07-----Myers N Y
 1201 Fullerton Bldg St Louis Mo
 Gantz, Maurice A CE '13-----R D 2 Troy O
 Civil Engineer
 *Garbi, Louis CE '07-----AEIC 5 Lincoln Ave Montreal PQ Can
 Gen Mgr Scottish Can Magnesite Co Ltd 705 McGill Bldg
 *Garney, Samuel CE '13-----1382 Prospect Ave N Y C
 Estmr and Desnr Atlantic Gulf & Pacific Co Manila P I
 Garrett, Robert P CE '97-----MASCE MECSIL 6234 Wash Ave
 Vice Pres Mo Br & Iron Co 1000 Fullerton Bldg St Louis Mo
 Garrett, Seymour S CE '04-----115 Oak Hill Rd Ithaca N Y
 Prof Sibley School of M E Cornell Univ
 Garrido, José CE '14-----228 Real St Manila P I
 Asst Supt Building Construction & Inspection City Hall
 *Gastmeyer, Robert W CE '11-----132 Barelay St Flushing N Y
 Asst Chief Engr Brewster & Co Long Island City N Y
 Gatsliek, Samuel L CE '11-----536 W 113th St N Y C
 Gavett, Weston CE '11 MCE '12-----MAWWA MNEWWA
 30 Church St N Y C [MAPubHA Plainfield N J
 Gebhard, John C CE '19-----219 E 18th St New York City
 Appr Beth Steel Bridge Corp 62 E Market St Bethlehem Pa
 Gehring, Edwin W CE '00-----MAMEDA MAAAS MACollPhysns
 Physician 156 Free St Portland Me
 Gehring, Herbert A CE '03-----AMASCE MAAAS MAPubHA
 Morris Knowles Inc Hippodrome Bldg Cleveland O
 Geibel, Edward M CE '16-----144 Millbank Ave Greenwich Conn
 Lubricating Oil Dept Socony Tientsin China
 Gelder, Walter H CE '98-----704 E Montgomery Ave Ashland Ky
 Engineer M of W Ashland Coal & Iron Ry Co
 Gelser, Charles S CE '03-----Dalton N Y
 Consulting Engineer
 *George, Edward CE '75-----Nassau N P Bahamas B W I
 4 Levin Rd Streatham Commons London S W Eng
 George, Henry H 3d AB CE '12 1831 Monument Ave Richmond
 [Va
 George, Sidney G CE '05-----Falls St Ithaca N Y
 Prof Mechanics School of Civil Engrg Cornell Univ
 Gerwig, Walter H CE '05-----131 13th St Parkersburg W Va
 Secy Bentley & Gerwig Furniture Co
 Getman, Frank L CE '99-----MASCE Lyons N Y
 Mfrs Rep Lonja del Comercio 518 Havana Cuba
 Gibb, Walton CE '09-----4650 Locust St Philadelphia Pa
 Manufacturer 313 Vine St
 *Gibbs, J Lynn CE '10-----1004 Decatur St Watkins N Y
 Asst Engr N Y State Hwy Comm Dryden N Y
 Gibson, G Edward CE '03-----115 No Allen St Albany N Y
 Assistant Engineer State Engrs Office Telephone Bldg
 Gideon, Abraham CE '95-----MASCE Army & Navy Club Manila
 Mgr Metropolitan Water Supply of Manila [P I
 Gifford, Robert L CE '91-----MASCE Oak Knoll Pasadena Calif
 Pres Illinois Engrg Co 21st St & Racine Ave Chicago Ill
 Gildea, Ray Y CE '12-----MECIBA 5225 York Rd
 Engr C & P Tel Co Baltimore Md
 Gillett, Maurice E CE '21-----913 McKoon Ave Niagara Falls N Y
 *Gillette, Harold S CE '10-----501 Wheat Bldg Ft Worth Tex
 Senior Highway Engineer U S Bureau Public Roads
 *Gilmore, Alvin L CE '08-----AASCE YMCA Binghamton N Y
 Cons Engr & Vice-Pres Bing Br Co Inc
 *Gilmore, Harry W PhB CE '01-----
 Giltner, Louis C CE '01-----Columbia Isle of Pines W I
 Cashier Nat Bank & Trust Co Nueva Gerona Isle of Pines W I
 *Glose, Robert L CE '15 Wissahiekon Ave & Clapier St German
 Secy-Treas National Steel Fabric Co Pittsburgh Pa [town Pa
 *Goepel, Frederick N CE '07-----137 E 13th St New York City
 *Goff, Albert L CE '11-----Elba Genesee Co N Y
 Drainage Engineer
 Golden, Harry E CE '91-----Myron St R F D 1 Sehnetady N Y
 Desng Engr General Electric Co Bldg No 23
 *Goldstein, Hyman W CE '12 1388 Eastern Pkwy Brooklyn N Y
 Chief Engr Bldg Products Co 67 E Long St Columbus O
 Goldstein, Joseph CE '18-----1748 Washington Ave N Y C
 Tech Appr Westinghouse El & Mfg Co Lester Pa
 Gomez, José A PhB CE '08-----AMASCE Box 713 Guayaquil
 Tech Comm for Sanitation of Guayaquil [Ecuador S A
 Gons, Louis R BS CE '13-----JASCE 24 Milk St Boston Mass
 Engr Fred T Ley & Co Inc
 *Gonzalez, Rafael CE '11-----35 San Sebastian St
 Building Construction San Juan P R
 Goodman, Benjamin S CE '14 JASCE 1642 Monroe St Balto Md
 1328 Broadway N Y C
 *Goodman, Max CE '12-----130 W 116 St New York City
 Industrial Consultant 30 Church St
 Goodman, Robert B CE '94-----Goodman Wis
 Manager Goodman Lumber Co
 Goodrich, Clinton R CE '05-----AMASCE Minonk Ill
 Engineer Dale Engineering Co Utica N Y
 Goodwin, Harry L CE '15-----MAAE Deerfield N Y
 Constr Supt The Texas Co Marcus Hook Pa

- Gordon, Fred F CE '93-----MASCE 75 So Union St
Civil Engineer Eastman Kodak Co Rochester N Y
- *Gordon, George CE '17-----117 Chenango St Binghamton N Y
Estimator Bldg Constr The Foundation Co N Y C
- Gouinlock, Harold CE '12-----Box 77 Warsaw N Y
- Gould, Carl A CE '07-----435 Humboldt St Denver Col
Supt of Constr Russel Engr Co Watson Utah
- *Grafman, William E CE '15 1507 Eastern Pkwy Brooklyn N Y
Engr Curtis Engineering Corp Garden City N Y
- Graham, Leland L CE '09-----506 Winsor St Jamestown N Y
Vice-President Chapman & Graham Inc 132 Blackstone Ave
- Graham, Roland R CE '12 AMASCE 217 McLean Ave Yonkers
American Bridge Co 30 Church St New York City [N Y]
- *Graham, Samuel A CE '11 c/o Wm. Allan 136 W 79th St NYC
Exporter Hides & Skins 114 Hunter St Sidney Aus
- *Graham, William S CE '16-----2306 Elsinor Ave Baltimore Md
Arch Repr for Geo A Fuller Co Pratt & Eutaw Sts
- Grantz, Walter A H CE '20-----44 72d St Brooklyn N Y
Lehigh Valley RR Hazelton Pa
- *Graves, Walter J CE '99 MASCE 134 Hazlewood Ave Detroit
Engr Mich Mutual Liability Co 1600 Real Estate [Mich
Exch Bldg]
- Gray, Edward T CE '01-----126 Tioga St Johnstown Pa
Civil Engineer Cambria Steel Co
- Gray, Joseph H CE '17-----1251 Dean St Brooklyn N Y
White Fireproof Constr Co 95 Madison Ave N Y C
- Gray, Ralph CE '21-----Maine N Y
- Greeley, Dana S CE '05 ME-----Cotton Exchange Bldg N Y C
Traveling Manufacturers Representative in South America
- *Green, Charles N CE '88-----MASCE 2848 Prospect Ave SE
Engr The Osborn Engrg Co Cleveland O
- Green, Francis K CE '21-----Middleburg Va
- Green, Joseph L CE '12-----4472 Oakenwald Ave Chicago Ill
- Green, Robert P CE '80 MCE '83-----MESPa Swarthmore Pa
Civil Engineer
- Greenawalt, William E CE '87-----85 So Sherman St Denver Colo
Metallurgist
- Greene, Carleton AB CE '91-----MASCE 151 W Turrell Ave
Cons Engr Greene & Greene 11 Broadway [So Orange N J
N Y C]
- Greene, Wallace CE '74-----2024 Hillyer Place N W
Patent Lawyer McGill Bldg Washington D C
- Grieg, Robert S CE '13-----Eldred Sullivan Co N Y
Asst Supt Constr Brookwood Farms Barryville N Y
- *Gridley, Haines CE '04-----MAIM&ME Auburn Calif
Mgr Oro Fina Mining Co and Mascot Gold Mining Co
- Gridley, William G CE '09 MAAE 106 E Chemung Place Elmira
Civil Engineer Constr Div War Dept Washington D C [N Y]
- Griffin, Lawrence CE '10-----148 Taylor Ave Beaver Pa
Ind Engr Jones & Laughlin Steel Co Woodlawn Pa
- Griffith, Fred C CE '20-----1426 Oneida St Utica N Y
With Turner Constr Co of N Y C Loch Haven Pa
- Grime, John R CE '15-----Cazenovia N Y
142 Magnolia Ave Arlington N J
- *Griswold, Hayden L CE '16-----Rocky Hill Conn
Chief Party & Inspr State Hwy Dept Norwich Conn
- *Griswold, Horace S CE '08 67½ Lincoln Ave Binghamton N Y
Retail Lumber Dealer
- *Griswold, Jonas W CE '01-----50 Grove St Pawtucket R I
- *Gronfine, John J CE '17-----845 Fillmore Ave Buffalo N Y
- Gross, Max CE '17-----752 Quincy St Brooklyn N Y
Draftsman Gas Dept Ritter-Conley Mfg Co Leetsdale Pa
- Grossman, Joseph G CE '12-----699 W 133d St N Y C
Machine Shop Auto Parts
- Grossman, Max CE '12-----Atlantic City N J
Manager Grossman's Hotel
- Gruener, Clarence E CE '07-----819 Church St Richmond Hill N Y
Civil Engineer
- Guest, John L CE '21-----1506 West Ave Richmond Va
- *Guilbert, Richard T CE '17-----536 W 113th St N Y C
Import & Export Fowler Boyd Leighton & Dubois Inc
- Gumboldt, Frank W CE '21-----Katonah N Y
- *Gurney, Frank M CE '12-----35 East St Oneonta N Y
City Engineer City Hall
- Guss, W Granville CE '06-----21 Hesketh St Chevy Chase Md
Arch & Civil Engr 403 Maryland Bldg Washington D C
- *Haas, S Ward CE '01-----42 Broadway N Y C
Desng Engr Katanga Belgian Congo
- Hacker, Theodore W CE '17 Woodcroft Apts Smithwood Ave
Civil Engr 615 Munsey Bldg Baltimore Md [Catonsville Md]
- Hadley, Eugene J BS '71 CE '73 LLB-----New Bedford Mass
Lawyer 6 Beacon St Boston Mass
- *Haeffner, Carl W Jr CE '05-----10 Chase St Newton Center Mass
- Haggart, Philip W CE '11-----5518 Center Ave EE Pittsburgh Pa
- Haggart, William H R CE '17-----1003 First Ave Fargo N Dak
- *Haight, Andrew H BS CE '97-----R D 27 Millbrook N Y
- *Hales, Felix S BE in CE CE '16 MAAE 1707 Belmar Rd Cleve-
Asst Engr N Y C & St L RR 530 Columbia Bldg [land O]
- Haley, Francis A CE '19-----630 Gotham St Watertown N Y
- *Hall, Bruce L CE '10-----Cooperstown N Y
Engineer 2612 No Calvert St Baltimore Md
- *Hall, Earle W CE '14-----107 Linden Ave Arlington N J
Asst Chf Draftsman Standard Oil Co Bayway N J
- Hall, Frederic F CE '00 MASCE 2411 Hillside Ave Berkeley
Struc Engr 251 Kearny St San Francisco Calif [Calif]
- *Hall, S Payson CE '10-----Box 256 Ridley Park Pa
- Ham, D Harvey CE '14-----824 Sixth Ave Spokane Wash
- Hamilton, Charles F CE '97-----MASCE 1407 Buffalo St
Gen Mgr Northwestern Constr Co Box 621 Franklin Pa
- *Hamlin, Harold F CE '05-----Lakeville Conn
- *Hammel, Victor F CE '07 MASCE 1001 No Center St Joliet Ill
Engr of Designs Elec Bond & Share Co 71 Broadway N Y C
- Hanchett, Willis H CE '14MAAE 147 Main St Brockport N Y
Asst Engr N C & St L RR 124 W 9th St Chattanooga Tenn
- Hancy, Albert P CE '10 AMASCE 301 Parkway Dr Syracuse
District Manager Corr Bar Co 303 Union Bldg [N Y]
- *Hanf, Porter V CE '15-----MAAE Box 97 San Bernardino Calif
Chief Draftsman So Sierras Power Co Riverside Calif
- Hankenson, John J BCE MCE '94-----Glencoe Minn
Railway Location and Construction
- Hanna, Elias S CE '13-----Suez Egypt
Engineer Egyptian State Rwy
- *Hannan, David E CE '07 AMASCE 4446 Drexel Blvd Chicago
Cons Engr and Architect 155 No Clark St [Ill]
- *Hanson, George C CE '08-----129 Main St Bridgeport Conn
American Consul Foochow China
- Hanson, Herbert C CE '09-1837 Monterey Rd S Pasadena Calif
- *Hardecker, John F CE '17 JASCE 8415 Manor Ave Wood-
Aero Drafts U S Nav Aircraft Fact Phila Pa [haven N Y]
- *Hardin, George D CE '13-----4816 Kenwood Ave Chicago Ill
Contractor Public Improvement Work 3139 Indiana Ave
- *Harding, Carroll R CE '10-----15 Woodruff Ave Brooklyn N Y
Asst Cons Engr Southern Pac Co 165 Broadway N Y C
- *Harding, Robert J CE '03-----MASCE 816 W Woodlawn Ave
V P & Gen Mgr San Antonio Water Supply Co San Antonio
Texas
- Harger, Wilson G CE '05-----16 Hinsdale St Rochester N Y
Engr 212 Masonic Bldg Lima O
- Harn, John E CE '15-----JASCE 3104 Remington Ave Balt Md
Secy & Treas Willard E Harn Co 2314 Oak St
- *Harrington, Arthur W CE '09-----AMASCE
Hyd Engr U S G S 704 Journal Bldg Albany N Y
- Harris, Charles W BS CE '05-----MPNWSE 5204 15th Ave NE
Acting Head Dept of Civil Engrg Univ of Wash Seattle Wash
- *Harris, Joseph S CE '13-----MAAE 937 E 156th St N Y C
Jun Engr Transit Constr Comm 49 Lafayette St
- Harrison, Alrich S CE '17-----431 Riverside Dr New York City
- Harrison, Bernard J CE '20 JASCE 1354 Dean St Brooklyn NY
Sales Engr Cutler-Hammer Mfg Co 50 Church St N Y C
- Harrison, Howard G CE '07-----Box 2176 Spokane Wash
Secretary The Day & Hansen Security Co
- *Harrison, Gerardus CE '10-----AMASCE Larchmont Gardens
Goldmark & Harrison Cons Engrs 103 [Larchmont N Y
Park Ave N Y C]
- Harshbarger, Elmer D CE '01-----AMASCE 2239 Wightman St
Pres Pitt Constr Co 1218 Fulton Bldg Pittsburgh Pa
- Hart, Emmet E CE '87-----MAREA 2101 Adelbert Rd
Chief Engr N Y Chi & St L RR Cleveland O
- *Hart, Linton CE '14 AMASCE 76 Marshall St Brookline Mass
V-P Rollin Constr Corp 80 Boylston St Boston Mass
- Hartman, Eugene L CE '11 806Susquehanna Ave W Pittston Pa
- Hartmayer, Herbert W K CE '20 60 W Oakwood Pl Buffalo NY
- *Hartwell, Clarence L CE '01-----69 Welles St Forty Fort Pa
I E Hartwell & Son Civil Engrs Wilkes Barre Pa
- *Hartz, Roger S B AB CE '13-----Palmyra Pa
With Claiborne-Johnston Contr Co Aguiar 71 Havana Cuba
- *Harwood, Warner CE '16 MAAE 1870 Wyoming Ave Washing-
Jr Engr Dept Highways Cook Co Chicago Ill [ton D C]
- Hashbrouck, Carl J CE '20-----Highland N Y
- *Haskell, Eugene E CE '79-----MASCE FAAAS Ithaca N Y
Dean Emeritus Coll Civil Engrg Cornell Univ
- *Haslam, Erwin E CE '96 MASCE 52 Columbia Ave Greenville
Hydr Engr Carnegie Steel Co Pittsburgh Pa [Pa]
- *Haswell, John R CE '09 AMASCE 402 Delaware Ave Wilming-
Specialist Farm Mech Ext Penn State Coll [ton Del
State Coll Pa]
- Hatt, W Kendrick AB CE '91 PhD MASCE MAREA Lafayette
Prof Civil Engrg Director Testing Lab Purdue Univ [Ind]
- *Hauck, Thomas S CE '10-----2225 Eutaw Place Baltimore Md
Lumber Business 717 S Caroline St
- Haupt, Max CE '06-----5 Plumstead Ave Lansdowne Pa
Civil Engineer 1713 Sansom St Philadelphia Pa

- Havens, Rodman W CE '80---MBklynEC 3202 Clarendon Rd
Civil Engineer Brooklyn N Y
- Havens, William L CE '16---AMASCE Edmeston N Y
Asst San Engr Div of Engrg & Constr Rm 618 City Hall
Cleveland Ohio
- Hawley, Abraham L CE '86---El Paso Texas
General Auditor El Paso & Southwestern R R Systems
- Hayden, John E CE '12---MLSMInInst Ishpeming Mich
Mining Engineer Cleveland Cliffs Iron Co
- Hayes, Edward CE '78---MASCE Cohoes N Y
City Engineer
- Hayes, Herbert E CE '09---18 Amity St Cohoes N Y
Engrg Examiner State Civil Service Comm Capitol Bldg
Albany N Y
- Hayes, Jeremiah J CE '16---1043 Clay Ave New York City
- *Hayes, John CE '97---Central Aguirre P R
Superintendent Ponce & Guayama R R
- Hayford, John F CE '89---MASCE MWSE FAAAS
Director Coll of Engrg Northwestern Univ Evanston Ill
- Healy, Edwin S CE '12---AAIEE
Engr Pacific Power & Light Co Portland Ore
- Healy, Gerald F CE '15---729 Gotham St Watertown N Y
Sales Mgr Real Estate 404 Dryden Bldg Flint Mich
- *Hedden, Edmond J CE '92---Bala Pa
Real Estate & Building 304 Finance Bldg Philadelphia Pa
- Hedden, Edward CE '87---Box 57 Boise Ida
U S Surveyor General for Idaho
- *Heidt, Charles CE '15---MAAE 973 Whitlock Ave N Y C
Engineer Grand Central Terminal Bldg
- *Heinitsh, George M CE '15---264 Spring St Spartanburg S C
- Heise, Walter F CE '11---5002 Walnut St Philadelphia Pa
Production Department A I S C Hog Island Pa
- *Heller, John W CE '01 AMASCE 9 Osborne Terr Maplewood
Engineering Contractor P O Bldg South Orange N J [N J]
- *Hemmings, Harry H CE '17---639 E Third St Brooklyn N Y
Sales Engr Overman Cushion Tire Co 250 W 54th St N Y C
- Henderson, Henry C CE '72 LLB---12 Greenridge Ave White
Lawyer Miles Building [Plains N Y]
- Henderson, Thomas R CE '07---514 So 42d St Philadelphia Pa
- Hendricks, Ernest D CE '03---MASCE Fort Plain N Y
Division Engineer State Engineer's Office Albany N Y
- Hendrickson, Geo L CE '11---R D 2 Danville Pa
Asst Engr Am City Engrg Co Peoples Bank Bldg Pittsburgh Pa
- Hendry, Robert W CE '14---1337 Pensacola St Honolulu T H
Engineer of Hilo Dept of Public Works & Co Engrs Off Hilo
T H
- Herman, Abbott P CE '19---627 Maplewood Ave Ambridge Pa
Draftsman American Bridge Co
- Hermann, Charles E CE '21---4601 Maryland Ave St Louis Mo
Prospecting Hotel Gastineau Juneau Alaska
- Herr, Frederick J CE '07---419 Fourth St Brooklyn N Y
Hardware Merchant 284 Fifth Ave
- Herriman, Morris W CE '20 320 No Franklin Ave River Forest
Bowling Green Ky [Ill]
- Herrmann, Frank CE '14 MAAE P O Box 1 Santa Fe N Mex
State Bridge Engineer
- *Hertel, Frederick E CE '15 104 Harnden Ave Watertown Mass
Jun Engr Str Div Stone & Webster 147 Milk St Boston Mass
- *Heslop, Paul L CE '14---JASCE MAAE
c/o J B Campbell Co Bourse Bldg Philadelphia Pa
- *Hess, Seth G CE '15---200 Cathedral Parkway N Y C
Real Estate 607 Fifth Ave
- Hettinger, Harold I CE '21---Stephens St Freeport Ill
- Hettrick, Ernest F CE '10 2848 Highland Ave Birmingham Ala
E F Hettrick Engr Co Engrs & Contrs
- *Heubeck, Elmer CE '12 Fifth Ave Rognel Hts Baltimore Md
Engr Pa Water and Power Co Lexington Bldg
- Hewitt, George W CE '09 119 Jefferson Ave Niagara Falls N Y
Cary-Hewitt Metal Works Inc Buffalo N Y
- Highley, Lee CE '97---New Meadows Ida
Banking
- Hilborn, Edwin CE '91---MSEENY MNGS Port Leyden N Y
Asst Engr Barge Canal Off Herkimer N Y
- Hilborn, William H CE '10---Phoenix N Y
County Engr Osecola Co Sibley Ia
- Hildreth, Norman E CE '09---44 Waverly St Pittsfield Mass
- Hill, Curtis CE '97---MASCE 4210 Holmes St
City Engineer Kansas City Mo
- *Hill, Harry W CE '13---1503 No Caroline St Baltimore Md
Lieut U S A Engrs Res Depot Schneectady N Y
- Hill, John E MS CE MCE '95---MASCE FAAAS 86 Taber Ave
Prof Civil Engineering Brown Univ Providence R I
- *Hill, Raymond C CE '12---261 Fair St Paterson N J
- Hill, Theodore W CE '93---Bellefontaine O
Contracting Engineer
- *Hillemeier, Arthur CE '09 58 West Seventh St Mt Vernon N Y
Civil Engineer
- Hillman, Charles A CE '17 1714 N H Ave NW Washington D C
- Hilpert, Meier G BS CE '01 MASCE Box 1054 Harrisburg Pa
Asst Engr Beth Steel Bridge Corp Bethlehem Pa
- Hilton, Joseph C CE '96 AMASCE 187 N 18 St E Orange N J
Supt Foundation Co N Y C
- Himes, Albert P CE '16 MAAE 8313 Cedar Ave E Cleveland O
Asst Engr N Y C & St L RR Co 520 Columbia Bldg
- *Hinck, Frederick W CE '10 MBEC1 359 E 25th St Brooklyn
Str Designer Buchman & Kahn Arehs N Y C [N Y]
- *Hinks, Warren H CE '12---846 Franklin St Johnstown Pa
Mem Firm Fetterman Engr Co 705 Johnstown Trust Bldg
- Hirsch, Emanuel CE '20---MAAE Amityville N Y
1007 Alleghany Ave Jersey Shore Pa
- *Hirsch, Herman D CE '10---1462 Park Place Brooklyn N Y
U S Steel Products Co Capetown S Africa
- Hiseock, George S CE '19---Box 1084 Southampton N Y
McClintie-Marshall Constr Co 730 Hill St Wilkesburg Pa
- Hoard, Prescott D CE '05---140 Wadsworth Ave N Y C
- Hobart, Charles B CE '98---Ventnor N J
Chief Engr Campeche-Laguna del Carmen Mex
- *Hock, Harold L CE '16---703 Main St Buffalo N Y
Assistant Engineer N Y State Comm of Highways
- Hoechn, Charles E CE '13---Albany N Y
Junior Engineer N Y State Barge Canal
- Hoff, Trygve W CE '21---Park St Upper Montclair N J
- Hoffeld, Henry R CE '87---Lancaster N Y
Mem Firm R Hoffeld Co 65 Carroll St Buffalo N Y
- *Hoffert, J Raymond CE '11---12 So 19th St Harrisburg Pa
District Engineer State Dept of Health
- *Hoffman, Charles A CE '17---1352 Perkiomen Ave Reading Pa
Ast Adv & Sales Prod Mgr Vanity Fair Silk Mills
- Hofstadter, Meyer CE '13---342 Stuyvesant Ave Brooklyn N Y
- Hogan, Joseph V CE '08 AMASCE 224 Paddock St Watertown
In ch Concrete Wk League Is Dry Dock [N Y]
- Hoge, Philip B CE '08---131 Conant St Elizabeth N J
Asst Engr Inv & Report C E Knoepfel & Co N Y C
- Holbrook, Roy B CE '10 23 Oxford Rd Newton Center Mass
Farmer, Royal Ridge Farm Front Royal Va
- *Holdredge, Earl B CE '11---1024 Euclid Ave Syracuse N Y
Sales Engineer Truscon Steel Co 440 The Gurney Bldg
- *Holland, Franklin E CE '12---4214 Western Ave Montreal Can
Manager Railway Sales Dept Sherwin-Williams Co of Can Ltd
- Holloway, Arthur P CE '07---223 Upper Mountain Ave Mont-
clair N J
- Holloway, Henry F Jr CE '15 223 Upper Mountain Ave Mont-
clair N J
- *Holmes, Edward CE '05 MAAE 2844 Rockwood Pl Toledo O
Terminal Engineer Willys-Overland Co
- Holmes, Edward B CE '12---216 Main St Keene N H
Mining Engr Rio de Janeiro Brazil c/o E J Lavino & Co
Phila Pa
- Holmes, Glenn D CE '96---MASCE 204 W Kennedy St
Chief Engr Intercepting Sewer Board 104 City Hall Syracuse
N Y
- *Holmquist, Carl A CE '10---
Asst Engr N Y S Dept Health Albany N Y
- Holt, Thomas B CE '19---Stewart Ave Ithaca N Y
Union Pacific Coal Co Roek Springs Wyo
- *Holzman, Jacob C CE '10 MSMENY 124 W 114th St N Y C
Civil Engineer
- Hood, Thomas S CE '21---124 East 32nd St Indianapolis Ind
Student Harvard Univ Cambridge Mass
- *Hooker, Elon H AB AM CE '94 PhD '96 907 Fifth Ave N Y C
President Hooker Electrochemical Co 25 Pine St
- Hopkins, Cecil B CE '07---AMASCE San Francisco Calif
President & General Mgr Steelform Contrg Co 681 Market St
- Hopkins, Frank S CE '11---50 So Clinton St Poughkeepsie N Y
Assistant Engineer Board of Public Works
- Hopkins, Howard C CE '03---2337 Fargo St Los Angeles Calif
Civil Engineer
- Horner, George W CE '73---R D 2 Belmont N Y
- Horton, Albert H CE '98 AMASCE MWSE 1307 Gallatin St
Hydr Engineer U S Geol Survey Washington D C
- *Horton, Philip Z CE '10---AMASCE Peoria Ill
Civil & Sanitary Engineer 401 Cent Nat Bank Bldg
- Hou, C Y MCE '19---31 Zan Ka Da Soochow China
c/o Am Bridge Co Pottstown Pa
- Hough, Floyd W CE '19---JASCE 82 Bridge St Catskill N Y
Jun Hydro & Geod Engr USC&GS Washington D C
- *Hough, Lawrence C CE '14---East Falls Church Va
Assistant Engineer Pitometer Co 25 Elm St N Y C
- *Houston, Levin J Jr AB CE '01 MAAE 602 Parkwyth Ave
City Manager Fredericksburg Va [Baltimore Md]
- *Howard, David A CE '11---3123 N St Washington D C
Civil Engr Army Medical Sch

- Howard, Thomas CE '01-----Portland Conn
Asst Engr N Y State Highway Comm Watertown N Y
- *Howe, Harry N CE '04-----AMASCE Memphis Tenn
Commr of Streets Bridges and Sewers
- Howell, Charles J CE '19-----24 So Seward Ave Auburn N Y
Sales Engr Pittsburgh-Des Moines Steel Co Pittsburgh Pa
- *Howell, Erie V CE '14 MCE '18-----JASCE Southampton N Y
Instructor School of Civil Engrg Cornell Univ Ithaca N Y
- *Howland, Charles A CE '12-----MAPHA 5822 Locust St
With Johnson & Benham Cons Engrs Kansas City Mo
- Howland, Rufus B CE '72-----Trumansburg N Y
Retired
- *Hoy, William W CE '95-----816 French St Santa Ana Calif
Street Superintendent & City Engineer
- *Hoyt, Herbert B CE '09 MAWPA 294 South Ave Bradford Pa
Superintendent Timber Preserving Plant B R & P Ry Co
- *Hoyt, John C CE '97-----AMASCE MWASCE
Hyd Engr U S Geol Survey Washington D C
- *Hoyt, Raymond H CE '15 180 Greyrock Place Stamford Conn
- Hoyt, William G CE '09 AMASCE 4618 So Salina St Syracuse
Engr Water Resources Branch U S G S Wash D C [N Y
- Hsu, Yush S CE MCE '12-----Tung Wu Col Soochow China
Asst Engr Canton Hankow Ry Changsha Hunan China
- Hu, Tung Chao BS in CE MCE '05-----MCHES Shanghai China
Chief Tech Dept Nanking-Hunan Ry Nanking China
- Huang, Chia-Chi MCE '18 MSSCh MCHES e/o S Y Tsu 22 E Yoa
e/o McClintic-Marshall [Chia Lung E Gate Shanghai China
Contr Co New Orleans La
- Huestis, Charles C AB CE '92 AMASCE 647 E Seminary St
President Carbon Mining Co Carbon Ind [Greencastle Ind
- *Hughes, Norman AB CE '10-----Jackson N C
Manager H & W W Newhern Co Powells Point N C
- Hulburd, Lucius S CE '03-----AMASCE Brasher Falls N Y
Sen Asst Engr N Y State Engrs Off Rochester N Y
- *Hulse, Shirley C CE '02-----AMASCE Bedford Pa
- Hunkin, Alger E CE '20-----17830 Lake Ave Cleveland Ohio
- *Hunkin, Samuel E CE '17-----15907 Lake Ave Cleveland Ohio
Construction Superintendent Hunkin-Conkey Constr Co
- Hunt, Clinton S CE '13-----527 Arnett Blvd Rochester N Y
Electric Bond & Share Co 71 Broadway N Y C
- *Hunt, Guy H CE '08-----2349 Bellfield Rd Cleveland O
Instructor in Mechanics Case School Applied Science
- Hunt, Sidney E CE '94-----Portlandville N Y
Minister Methodist Episcopal Church
- Hurlbut, Hinman B CE '01-----AMASCE 125 Elm St Montclair N J
- Hurlby, John P CE '07-----AMASCE
U S Consul Riga Russia
- Hurley, John W CE '10-----2012 Harbert Ave Memphis Tenn
Jun Engr U S Engr Off Charge Revetment Constr
- *Hutchinson, James H CE '06-----413 No Union St Olean N Y
Engr Est See Design Div DuPont Co Wilmington Del
- *Hutson, Arthur C BS CE '05-----140 No 16th St E Orange N J
Off Engr Nat Board Fire Underwriters N Y C
- Hyatt, Edward K CE '10-----St Louis Mo
Pres Taylor-Hyatt & Co Contrs
- Hyde, Alfred T CE '73-----Lorton Va
Constr Cumberland Pipe Lines in Kentucky
- Hyde, Edward W CE '72 MCE '74-----MATA 814 Lincoln Ave
Actuary Columbia Life Ins Co 4th & Elm Sts Cincinnati O
- *Hyde, Howard E CE '00 MASCE 302 W Seneca St Ithaca N Y
President Young & Hyde Inc Prod Exch Bldg N Y C
- Hyde, Richard L CE '17 JASCE 411 Friendship St Providence
[R I
- *Hynds, Harold D CE '12 AMASCE 61 Pierpont St Bklyn N Y
Constr Engr Turner Constr Co 244 Madison Ave N Y C
- Icasiano, Abelardo R CE '17-----MAAE Bulacan P I
- *Iglehart, Joseph A W CE '14-----1406 Park Ave Baltimore Md
Mem Firm Brooke Stokes & Co 102 St Paul St
- Infanger, Adolph O CE '18-----90 Glen St Brooklyn N Y
- Ingalls, Owen L CE '86-----22 Morningside Ave N Y C
Assistant Engineer U S Engineers Office Galveston Tex
- *Ingalls, Robert D CE '17-----Phelps N Y
Capt 6th Engrs Camp Pike Ark
- *Ingersoll, Vernon S CE '98 10 Scott Place Rockville Center NY
Civil Engineer
- Irving, James N CE '11-----AMASCE 525 So Van Ness Ave
Asst Engr Quinton Code & Hill Cons Engrs Los Angeles Calif
- Irwin, A Charles BS MCE '16 MAAE MAREA 4450 No Rich-
Engineer Portland Cement Assoc Chicago Ill [mond St
- Ivanek, Bertram B CE '20-----Mt. Hermon Mass
- *Jackson, J Ceylon CE '15-----New Milford Pa
Junior Engineer U S Engineer Dept First District N Y C
- Jackson, Leon E CE '10-----Greene N Y
Engineer Roch Ry & Lt Co Rochester N Y
- *Jackson, William CE '90 7417 Church Ave Ben Avon Pittsburgh
Engr American Bridge Co Ambridge Pa [Pa
- *Jacobs, Robert H CE '93 MASCE 55 E 65th St New York City
Div Engr Transit Constr Comm 49 Lafayette St
- *Jacoby, Hurlbut S AB '08 CE '10 AMASCE 6523 Euclid Ave
Secretary & Chief Engineer H K Ferguson Co [Cleveland O
- *James, Robert L CE '12 JASCE MSPEE 21 W 93d St N Y C
Tech Dept Vacuum Oil Co Lisbon Portugal
- Janney, William H CE '74-----1815 No Charles St Baltimore Md
- *Japhet, W Ernst BS CE '08-----Box 735 Houston Tex
Engineer Petroleum Refining Co
- Jaret, Milton AB '13 CE '14-----1957 85th St Brooklyn N Y
- Jarvis, George M CE '78-----742 E Penn Ave San Antonio Tex
Retired
- Jenkinson, Richard D CE '07-----15 N Howard Ave Bellevue Pa
Real Estate and Insurance 507 Lincoln Ave
- *Jennings, Louis C CE '10-----135 Pelham St Newport R I
Res Engr The Foundation Co Ltd St Jerome P Q Can
- *Jenrick, William F BS CE '10 AMASCE 113 White St Waverly
Estmr Stone & Webster Engrg Corp 147 Milk St [Mass
Boston Mass
- *Johnson, Albert M CE '95-----6353 Sheridan Road Chicago Ill
President National Life Ins Co of U S A 29 So La Salle St
- Johnson, Albert T Jr CE '11-----923 No Madison Ave Peoria Ill
Plant Engr Great Western Electro-Chem Co Pittsburgh Calif
- Johnson, Berkeley CE '20-----93 Fairfax Road Worcester Mass
Water Resources Branch of the U S G S 615 Idaho Bldg
Boise, Idaho
- Johnson, C Reid CE '13-----2902 St Paul St Baltimore Md
Lieut (jg) CEC USN Submarine Base New London Conn
- Johnson, Donald S CE '15-----Evanston Hotel Evanston Ill
- Johnson, Eugene C CE '05-----686 Catalina St Los Angeles Calif
Chief Engineer Pacific Elec Ry Co
- *Johnson, Harvey S CE '11 AMASCE 65 Sussex St Port Jervis
Asst Engr Bossert Corp 1408 Oneida St Utica N Y [N Y
- Johnson, Hollister CE '12-----AMASCE Dryden N Y
Asst Engr N Y State Conservation Comm Watertown N Y
- *Johnson, James A CE '13-----Warsaw N Y
President Oatka Engineering & Construction Co Inc
- *Johnson, Lawrence CE '01-----Collinsville Conn
Civil Engineer
- *Johnston, Clifford C CE '12-----26 Morningside Ave N Y C
Mgr Empire State Advertising Agency Albany N Y
- *Johnston, Edgar CE '00-----733 Park Ave E Orange N J
Mgr Oakwood Plant Mountain Ice Co Orange N J
- Johnston, Jesse C CE '13-----308 E Olive St Lamar Colo
Merchant
- Johnston, Miles C AB BS CE '12 707 Chamber of Commerce
Paymaster Henrico Lumber Co Richmond Va [Bldg
- *Johnston, William R Jr CE '05-----28 Yale St Maplewood N J
Engineer L V R R 143 Liberty St New York City
- *Jones, Bevan CE '06-----174 W 89th St N Y C
- Jones, Harold H CE '10-----96 Norwood Ave Buffalo N Y
Secy & Treas Lapan Logging Co Jackson Bay B C Can
- Jones, Henry H CE '20-----Durham N C
- Jones, Jacob O BS MCE '15 MASCE MSPEE 1714 Indiana St
Asst Prof Hydraulics Univ of Kansas [Lawrence Kan
- *Jones, William M CE '18-----480 Convent Ave N Y C
Turner Constr Co 244 Madison Ave
- Joseph, Louis W CE '20-----Warrensburg N Y
- Joseph, William B CE '13 1201 W Seventh St Wilmington Del
- Judson, David H CE '07-----421 Stolp Ave Syracuse N Y
Truseon Steel Co 440 Gurney Bldg
- *Justin, Joel D CE '06 MASCE 743 Amherst St Buffalo N Y
e/o Ludlow Engrs Winston-Salem N C
- *Kalberg, S August CE '10 AMASCE 39 Dwight St New Brit-
[ain Conn
- Kampf, Louis CE '09-----33 Division St Norwich Conn
Textile Engineer Anderson Meyer & Co Tientsin China
- *Kaufman, Abraham CE '15 e/o Dr A Isaacson 1477 Washing-
[ton Ave New York City
- *Kaufman, Ernst G CE '11 AMASCE 315 Adelphi St Brooklyn
e/o L V R R 90 West St N Y C [N Y
- *Kaufman, Morris L CE '12-----918 E Parkway Brooklyn N Y
Kaufman & Levine Cons & Ind Engrs 56 Pine St N Y C
- Kaufman, Samuel CE '19-----1389 Stebbins Ave N Y C
Asst Engr United Flee Light & Power Co 130 16th St
- Keating, Thomas F Jr CE '17-----11 E 87th St New York City
Insp & Serv Dept Pate & Robb Ins Brokers 100 Williams St
- *Keays, Reginald H CE '95 AMASCE 2680 Hudson Blvd Jersey
Engr Degnon Contracting Co Allaben N Y [City N J
- Keeler, Louis V CE '13-----217 Jewett Ave Jersey City N J
Field Secy The Rubber Assn of Amer 17 Battery Pl N Y C
- *Keenan, James N CE '09-----461 W 159th St New York City
Dist Sales Manager H H Robertson Co 170 Broadway
- Kehler, Sherman I CE '94 MCE '03-----1800 Oakley St Baltimore
B & O Office Building [Md
- Kehoe, Harry CE '08-----161 E Third St Oswego N Y

- Kehrhaun, Charles J *CE* '09 MAAE MCIES 13600 Fourth Ave
Asst Engr Dept Grade Crossing Elim [E Cleveland O
N Y C & St L R R Cleveland O
- *Keller, Arthur R *CE* '03 AMASCE 2456 Oahu Ave Honolulu
Dean College of Applied Science Univ of Hawaii [T H
- Kelley, Charles L *CE* '85-----Main St Savannah N Y
Civil Engineer
- *Kelley, George B *CE* '08-----1 Thirteenth St Upper Troy N Y
Junior Engineer N Y State Barge Canal
- Kelley, William D *BS MCE* '81 MASCE Long Island City N Y
Pres Kelly & Kelley 12th St & Vernon Ave N Y C
- Kellogg, George D *CE* '07-----Greenwood N Y
Asst Engr N Y State Engineers Dept Albany N Y
- *Kelly, Edward DeV *CE* '10-----Oriskany N Y
- Kelly, Edward J Jr *CE* '12-----61 W Erie Ave Corning N Y
- Kelsey, Clifford S *BA CE* '88-----162 Remsen St Brooklyn N Y
Vice-Pres Realty Associates
- Kelsey, Sidney E *CE* '87-----1824 Jefferson St Kansas City Mo
- *Kendall, Charles H *CE* '95 MS MASCE 1501 College Ave Ft
Asst State Highway Engineer Austin Tex [Worth Tex
- *Kennedy, James C *CE* '79-----Carson City Nev
507 Tenth St Sacramento Calif
- Kennedy, Robert C *CE* '21-----East Rochester N Y
- *Kerby, Charles K *CE* '15-----40 Rugby Road Brooklyn N Y
Thompson Starrett Co Long Island City N Y
- *Kerby, Russell T *CE* '13-----1019 Kenmore Place Brooklyn N Y
Engr Am Tel & Tel Co 195 Broadway N Y C
- Kessler, William C *CE* '13-----23 Ninth St Woodside N Y
Asst Engr U S G S 328 Custom House San Francisco Calif
- *Kibbe, Harmon C *CE* '16 JASCE 2722 Ashby Ave Berkeley Cal
Salesman Cobbledeck-Kibbe Glass Co
- Kidde, Reguar T *CE* '13-----215 W 101st St New York City
- Kiddie, John *CE* '04-----MAAE MAIM&ME Morenci Ariz
Division Mine Superintendent Arizona Copper Co
- Kiep, Henry A Jr *CE* '10-----R F D 55 Westfield N J
Industrial Finance Dept Robertson Cole Co N Y C
- Kimber, George F *CE* '12-----Augusta St Kingston N Y
- *King, Alvin W *CE* '07-----108 E Moreland Ave Chestnut Hill
Sales Mgr Fulton Co 50 Church St N Y C [Phila Pa
- King, Clifford M *AB CE* '04 AMASCE MASE 3287 Bradford
Asst San Engr 618 City Hall [Rd Cleveland Hts O
Cleveland O
- *King, Everett E *AB CE MCE* '11 AMASCE MAREA Urbana
Prof Ry Civil Engineering University of Illinois [IH
- *King, Leon T *CE* '10-----20 James St Ilion N Y
Jun Engr N Y State Barge Canal Herkimer N Y
- King, Paul *CE* '16-----Emporia Va
Engr & Survr Atlantic Coast Realty Co Petersburg Va
- King, Tang *MCE* '21 e/o Mr D Y Chin 406 Hankow Rd Shang-
[hai China
- King, Tao *CE* '12-----AMASCE 33 Tou Fa Hutang West City
Res Mem Comm on Ry Technics Min of Communications
Peking China
- Kingsland, Lawrence D II *CE* '17-----Hotel Beers St Louis Mo
Civil & Hydr Engr Foundation Co Rifa 332 Lima Peru S A
- Kinnear, Eugene C *CE* '07 1882 Columbia Rd Washington D C
Sen Str Engr ICC Bur Val San Francisco Calif
- *Kipp, Frederiek M Jr *CE* '14-----JASCE 3705 Chestnut Rd
Asst Conservation Engr City Water Dept Baltimore Md
- *Kirschner, Charles C *CE* '14-----JASCE 427 Fourth St Troy N Y
Asst Engr Bd of Commrs Port of New Orleans La
- Klaber, John J *CE* '06-----124 W 88 St New York City
Marble Export Florence Italy
- Knapp, Frank H *CE* '11-----AMASCE Blasdel N Y
U S Reclamation Service El Paso Tex
- Kneeland, Herbert D *CE* '10-----MESWPa 230 Breeding Ave
Prod Mgr Untd Engrg & Fdry Co 2311 Farmers [Pbgh Pa
Bank Bldg
- Knighton, John A *CE* '91-----MASCE 207 W 107th St N Y C
Div Engr (Harlem River Div) Dept Pl & Str 2221 Madison
Ave
- Knoch, Julius J *MS CE* '92 AMASCE 1717 Gains St Little Rock
Carter & Knoch Cons Egnrs 803-807 A O U W Bldg [Ark
- Knowlton, George E *CE* '20-----Blake Bros & Co Box 607 N Y C
- Knowlton, Robert H *CE* '06 MNELA MAIEE 211 Cornell Ave
Power Engr United Gas Impr Co Phila Pa [Swarthmore Pa
- Koester, Edwin F *CE* '13 AMASCE 811 West St Wilmington
Engineer in Charge Surveying Department [Del
- Kohn, Arthur H *CE* '06-----21 No Lime St Lancaster Pa
- Kolherk, Andrew *CE* '12-----305 E 161st St New York City
Assistant Engineer I R T Co 156 Broadway
- Koo, See Sun *MCE* '19 PhD '21 MESCH Nai Wai Shanghai
[China
- Koopman, Jacob *CE* '13-----e/o Arthur McMullen Co N Y C
Engineer with Arthur McMullen Co of New York Cheswick Pa
- Korff, Harry O *CE* '16-----1720 W Lafayette Ave Baltimore Md
- *Kornfeld, Harry *BS CE* '11-----AMASCE 106 Stratford Ave
Desng Engineer General Electric Co [Pittsfield Mass
- Kraft, George L *CE* '15-----1730 First St N W Washington D C
Captain Infantry U S A e/o Adjutant General of the Army
- Kramer, Edwin W *CE* '06-----1801 So Fifth St Missoula Mont
Dist Hydr-Elect Engr U S-For Service 508 Montana Bldg
- Kratzenstein, Hugo *AB CE* '04-----7 E 94th St New York City
Civil Engineer 152 W 88th St
- Krause, Alois W *CE* '12-----152 Crafts St Newtonville Mass
- Seey Geo E Warren Co 35 Congress St Boston Mass
- Krauss, John S *CE* '17-----974 St Nicholas Ave New York City
- Kristal, Frank A *CE* '08-----223 Highland Ave Trenton N J
Assistant Sales Engineer DeLaval Steam Turbine Co
- *Kronberg, Sol *AB CE* '08-----615 W 150th St New York City
Seey Supertone Talking Machine Co 18 W Twentieth St
- *Kruze, Otto V *CE* '09-----AMASCE Philadelphia Pa
Hyd Engr Larner Johnson Valve & Engrg Co Widener Bldg
- *Krusi, Herman *CE* '82-----2033 Central Ave Alameda Calif
Retired
- Kuck, John F R *BS CE* '12-----MAAE 22 W Harris St
Asst Engr Central of Ga Ry Savannah Ga
- Kurelas, Max *CE* '18-----63 E 177th St New York City
Civil & Refrig Engineer U R D Green 154 Nassau St
- *Kurtz, Ford *CE* '07-----MASCE New York City
With J G White Engrs Corp 43 Exchange Pl
- *Kurz, Ernst W *CE* '17-----910 Five Oaks Ave Dayton O
Structural Engineer Schenck & Williams Dayton O
- LaBrique, Henry F *CE* '07-----126 Winthrop St Brooklyn N Y
- *Lacazette, Alfred A *CE* '13-----ASME MCuSE Vedado Havana
W India Cil Co of N Y Calle 2 entre 9 y 11 [Cuba
- *LaCroix, Arthur E *CE* '16-----734 Pleasant St Worcester Mass
Asst Hydr Engr New England Power Co 35 Harvard St
- Lahr, Charles *CE* '15-----51 Chicago St Elmhurst Mass
Jun Engr N Y State Pub Ser Comm 1st Dist N Y C
- Lamoureux, Vincent B *CE* '20-----Forest Home Ithaca N Y
Jr Engr USGS Washington D C
- Lanahan, Howard G *CE* '09-----Tacoma Wash
Manager Hurley Mason Co 500 Equitable Bldg
- Lance, John H *CE* '96-----MASCE 426 Rutter Ave Kingston Pa
Cons Engr 616 2d Nat Bank Bldg Wilkes-Barre Pa
- Lance, William L *CE* '08-----426 Rutter Ave Kingston Pa
With J H Lance Cons Engr Wilkes-Barre Pa
- Landa, Francisco *CE* '07-----MCuSE Paseo 194 Vedado
Engr Insptr Hav Elec Ry Light & Pow Co Havana Cuba
- *Landis, Charles W *CE* '00-----14 Hamilton Ave Cranford N J
Asst Contr Mgr U S Steel Products Co 30 Church St N Y C
- Landon, Eugene A *CE* '80-----MASCE Groton N Y
Secretary and Treasurer Begent Lumber Co
- Lane, Emory W *CE* '14 AMASCE 1038 Heath St Lafayette
Mgr China Off Morgan Engr Co Yang Chow China [Ind
- *Lanpher, Edwin E *CE* '99-----540 Sheridan St Pittsburgh Pa
Division Superintendent Bureau of Water
- Lara, Edward M *CE* '03-----Bend Ore
Cashier First National Bank
- Larned, William H *CE* '84-----Haigler Neb
Cashier State Bank of Haigler
- Lathrop, John P *CE* '92-----MECIPh Wayne Pa
Civil Engineer and Contractor Overbrook Pa
- Latting, Benjamin F *CE* '94-----Care C H Latting Shortsville N Y
Assistant to Chief Engr Indiana Bridge Co Muncie Ind
- Lau, Waau W *AB CE* '14 '15-----Tientsin China
Assistant Engineer River Improvement Comm
- Lavine, I William *CE* '15-----272 Koseiusko St Brooklyn N Y
- Lawrence, Frank E *CE* '06 AMASCE 415 W 36th St Savannah
President Lawrence Construction Co Augusta Ga [Ga
- Lawrence, Theodore F *CE* '88-----Chester N Y
Cheese Manufacturer
- Lawson, David T *CE* '73-----
- Lay, Charles H *CE* '74-----149 W Third St Oil City Pa
Retired
- Lazo, Antonio *CE* '07-----108 E 82d St New York City
Investment Banker 115 Broadway
- *Leebler, Bruno C *CE* '08 LLB-----MASME Maywood N J
Genl Mgr S S Hepworth Co of New York City
- Ledger, William H *MCE* '95-----MICE Railway Crescent Bareroff
Metropolitan Railway Construction Sydney N S W
- *Lee, A Carl *CE* '10-----MASCE
Div Engr Southern Power Co Charlotte N C
- Lee, Don *BS in CE CE* '13-----AMASCE San Angelo Tex
Sales Engr Lakewood Engrg Co 711 Sumpter Bldg Dallas Tex
- Lee, Haw-Shen *CE* '16-----Yu Yao Chekiang China
Eng Seey to Chf Engr Tientsin-Pukow Ry Tientsin China
- *Lee, K *MCE* '17-----
- Lee, Kohn Sam *CE* '13-----14 Helen Terrace Shanghai China
Business

- Lee, Teh Tsing *CE '11 MCE '12*-----Tientsin China
In charge Des & Dr Off Wks Dept Chili Riv Comm
- Leggett, Edward H *CE '12 MAIBSCE 8 So Allen St Albany*
Ludlum Steel Co Watervliet N Y [N Y
- Lehman, Alvin S *CE '21*-----339 Moss Ave Peoria Ill
- *Lehrbach, Henry G *CE '15 AMASCE 363 Dearborn St Buffalo*
Lieut (S G) C E C USN San Diego Calif [N Y
- *Lehrbach, Warren W *CE '17*-----363 Dearborn St Buffalo N Y
Office Ex McGraw-Hill Co Inc New York City
- *Lent, C. Hersey *CE '11*-----2411 Beverley Road Brooklyn N Y
Sec Brown Lent & Pett Inc 90 William St N Y C
- *Leonard, Edward P *CE '09*-----401 Macon St Brooklyn N Y
With Alexander Bros Leather Mfrs Philadelphia Pa
- *Leonard, Samuel J *CE '17*-----520 G St NE Washington D C
- Leschen, William F *BS CE '09*-----6409 Enright St St Louis Mo
Oil and Coal By-Products 601 Bank of Commerce Building
- *Lessin, Samuel *CE '12*-----1578 Union St Brooklyn N Y
Junior Engineer N Y State Pub Ser Comm N Y C
- Leung, Chin-Yuk *CE '14 MCE '15* Jardine Matheson & Co
[Tientsin China
- Levine, Harold J *CE '12*-----AMASCE 140 E 92d St N Y C
Kaufman & Levine Cons & Ind Engrs 56 Pine Street.
- *Levine, Lionel M *CE '10*-----530 Manhattan Ave
Cons Engr 29 Broadway New York City
- Levine, Samuel *CE '11*-----355 Riverdole Ave Brooklyn N Y
- *Levy, Robert *CE '13*-----P O Box 598 Woodmere N Y
Mgr Textileleather Co Brown St & Lister Ave Newark N J
- Lewis, Clarence C *CE '91 MASCE 1815 E 89th St Cleveland O*
Gen Mgr Cia Luz y Fuerza Cordoba Argentina S A
- Lewis, Dudley L *CE '08*-----2509 May St Fort Worth Tex
City Engineer City Hall
- Lewis, John H *CE '03*-----AMASCE MOrSE Portland Ore
Lewis & Clark Cons Engrs 805 Chamber of Commerce Bldg
- *Lewis, John M *CE '08*-----MAIM&ME Elkhorn W Va
Chief Engineer Houston Interests
- *Lewis, Roger *CE '95 LLB*-----320 W. 78th St New York City
Lawyer Care Guthrie Bangs & Van Snideren 44 Wall St
- *Li, Chuan Heng *CE '18*-----18 Kennedy Road Hong Kong China
Genl Supt of Inspin M of W Dept Yueh-Han R R
- Li, Kien Yo *CE '11*-----Kalgan China
Office Chief Engineer Peking Kalgan Ry
- Liebeskind, Morris *CE '21*-----215 E 103d St New York City
- Lilly, Scott B *BS CE '09*-----148 Parkside Ave Brooklyn N Y
Sales Engineer 30 Church St New York City
- Lindau, Sigmund B *CE '18 MAAE 612 Summit Ave Greensboro*
Civil Engr N Y State Hwy Dept Hornell N Y [S C
- Lindberg, Henry E *CE '19*-----900 Federal St Pittsburgh Pa
Designer Pittsburgh-Des Moines Steel Co 607 Curry Bldg
- Linnell, Herbert H *CE '20*-----JASCE 19 Florentine Garden
Engr Miranda Sugar Co Central Miranda [Springfield Mass
Oriente Cuba
- Linsley, Charles W *CE '07 AMASCE 52 E Utica St Oswego N Y*
Plant Engr Oswego Candy Works Long's Chocolate Works
- Linton, Orlando H *CE '06*-----University Club Montreal Can
Vice-President Canadian Comstock Co Ltd Constr Engrs
- *Livant, Charles D *CE '17*-----1413 Grant Ave Bethlehem Pa
- Livemore, Norman B *CE '95*-----MASCE San Francisco Calif
Pres N B Livemore & Co 1306 Merchants Nat Bank Bldg
- *Lo, Chung Chem *CE '10*-----Nan Ying St Foochow China
Principal Tangshan Engrg College Tangshan China
- *Lo, Ying *CE '16*-----JASCE Hae-Don-Hon St Nan Chang China
- Loeberby, Robert A *CE '06*-----87 St Matthew St Montreal Can
- Lockwood, Ralph H *CE '73*-----6326 Lakewood Chicago Ill
Retired
- *Loeffler, Hermann C *CE '16*-----21 McKinley Ave Glendale N Y
- Loh, Yuen Chang *CE '14* North Chekiang Road Shanghai China
Assistant Superintendent of Construction Standard Oil Co
- *Long, Arthur M *CE '12*-----122 Porter Ave Warren O
Asst Gen Mgr Sales Dept The Trumbull Steel Co
- Long, Guy E *CE '02*-----226 Reynolds St Kingston Pa
Civil Engineer
- *Longwell, John S *AB CE '10*-----AMASCE Powell Wyo
Engineer U S Reclamation Service
- Loomis, Arthur B *BS MCE '94*-----Toledo O
Chief Engr Structural Dept Toledo Bridge Crane Co
- Loomis, Van Wyck W *CE '14*-----167 Queen St Sarnia Ont Can
- *Loomis, Willis H *CE '94* 28 Rock Island St Gouverneur N Y
President Mining Co
- Lopez, Carlos *CE '09*-----Iloilo Iloilo P I
Surveyor 34 Yznart St
- Lord, Charles H *CE '11 MAWWA Crescent Park Ogdensburg*
Superintendent City Water Works [N Y
- Lord, George W *CE '20*-----1550 Ashland Ave Evanston Ill
e/o So California Edison Co Los Angeles Calif
- Lordly, Henry R *CE '93 MCE '20 MASCE MEIC 74 Strathearn*
Cons Engr Montreal P Q Can [St
- *Lott, Henry D *CE '15*-----370 E 23d St Brooklyn N Y
Field Engr Post-McCord Construction Co N Y C
- Love, Albert J *CE '09*-----92 Downer Place Aurora Ill
Vice President Love Brothers Inc
- *Loveland, Chester H *CE '10 MASCE 2730 Garber St Berkeley*
Hyd Engr State R R Comm 953 Flood Bldg San Francisco Calif [Calif
- *Lovell, Earl B *CE '91 AMASCE 160 Broadway New York City*
Prof Civ Engrg Col Univ Mgr & Chf Engr E & S Dept
Lawyers Title & Tr Co Vice-Pres Charles Hansel Co
- Lu, Feng Shu *CE '18 MChES Wushih City Kiang-Su Pro China*
Naugand Ry & Mining Coll Shanghai China
- Lucchetti-Otero, Antonio S *CE '10*-----AMASCE San Juan P R
Asst Chief Engr Porto Rico Irrigation Service Guayama P R
- Lucchetti, Raul *CE '20*-----e/o Ledo Manuel Toro l'once P R
P R Irrigation Service San Juan P R
- Ludlow, J Wyman *ME CE '03*-----MASCE ME&AAS 552 12th St
Harbor Engineer Port of Los Angeles City Hall San Pedro
Calif
- Lum, Paul B *CE '07*-----MSAutoE 1361 Otis Place N W
Mgr Autoecar Sales & Service Co 1240 Penn Ave NW Wash DC
- *Lund, Gabriel E *CE '17 AMASCE e/o Mr. Alexander 151 W*
Supt of Constr W I Sugar Finance Corp Cayo [86th St N Y C
Mambi Oriente Cuba
- Lyerly, Charles A Jr *CE '09* 4487 McPherson Ave St Louis Mo
- *Lyle, Alexander Jr *CE '13*-----61 W 50th St New York City
Assistant Engineer H D Best & Co Flatiron Bldg
- *Lyman, Richard R *BS MCE '03 PhD '05 AMASCE Salt Lake*
Prof Civ Engrg U of Utah Pres Lyman-Callister Co [City Utah
- *Lynch, Edmund *CE '12 MAAE 39 So Emily St Crafton P O*
Asst in San & Welfare Dept Amer Sheet & Tin Plate Co
Pittsburgh Pa
- Lynch, James H Jr *CE '19 MAAE 237 Plymouth Ave Buffalo*
Office Engineer Erie R R Hornell N Y [N Y
- MacBean, John P *CE '20*-----Lawnton Ave Oak Lane Pa
With City Engr St Petersburg Fla
- *MacDiarmid, Milo S *CE '95*-----MASCE MDeES Northville Mich
Asst Engr U S Lake Survey 205 Old Custom House Detroit
Mich
- MacDonald, Harold G *CE '07*-----Edmonton Alberta Can
- MacGregor, Ross E *CE '18*-----109 Rogen Ave Brooklyn N Y
With N J D W S Comm Wanague N J
- MacHarg, John B *CE '93 AB PhD*-----414 W 121st St Rome N Y
Professor of History Lawrence Coll Appleton Wis
- MacKellar, Gordon *CE '20*-----147 No Church St Hazleton Pa
- MacKen, Harold I *CE '20* 62 Westervelt Ave New Brighton N Y
- *MacKrell, Edwin A *CE '12*-----971 E 18th St Brooklyn N Y
Engr D L & W R R Hoboken N J
- *MacLeod, Norman L *CE '11*-----4947 Kimbark Ave Chicago Ill
Assistant Nearner Ager & Lord Tie Co 80 E Jackson Blvd
- *MacVeagh, Wayne *CE '16*-----472 Hepburn St Williamsport Pa
Engrg Dept Valley Mould & Iron Corp Sharpsville Pa
- McArthur, Joseph W *MCE '17 MAAE 1873 Garden St Eugene*
Bridge Engineer Lane County Ore [Ore
- *McCarthy, John R *CE '17* 4761 Richardson Ave New York
Jr Engr Crew Levick Co Philadelphia Pa [City
- *McCaustland, Elmer J *CE MCE '97 MASCE MECISTL MAAE*
Dean of Engrg Dir Engrg Exp Sta Univ of Mo Columbia Mo
- McClain, Carl A *CE MCE '16 MAAE AMASCE 1033 High St*
General Supt & Sec Eugene Water Board Eugene Ore
- McClintock, Ward G *CE '13*-----108 E Marshall St Ithaca N Y
Engineer Dept Bldgs & Grounds Cornell Univ
- McClure, John H *CE '19*-----928 Western Ave Pittsburgh Pa
Draftsman Pittsburgh-Des Moines Steel Co
- McClure, Ross G *CE '16 MAAE 4535 W End Ave Chicago Ill*
- *McConnell, Ira W *CE '97*-----MASCE MAAE MBosSCE
V-P Dwight P Robinson & Co Inc 125 E 46th St N Y C
- McCormick, J Gould *CE '10*-----909 Main St Monongahela Pa
- *McCrone, Walter C *CE '14*-----602 Hector St Ithaca N Y
- McCurdy, George E *CE '05*-----Berwyn Ill
316 Wildwood Ave Akron Ohio
- McCurdy, John C *BS CE '12*-----Forest Home Ithaca N Y
Professor Rural Engrg Coll of Agr Cornell University
- *McDowell, Edwin T *CE '14*-----77 So Main St Middletown Conn
Superintendent of Public Works Norwood Mass
- McGowan, Henri C *BS EE CE '17* 2624 Walton Way Augusta
Sales Engr H W Johns-Manville Co 210 No Broad St [Ga
Philadelphia Pa
- *McHarg, Leslie *CE '99*-----AMASCE MNYYRRCI
Contr McHarg-Barton Co 1328 Broadway
- *McHugh, Austin G *CE '14*-----71 Aldrich St Buffalo N Y
Draftsman Youngstown Sheet & Tube Co Youngstown O
- McKaig, Thomas H *BArch CE '13*-----Orchard Park N Y
Engr Nat Analine & Chem Co Buffalo N Y
- McKee, William J *CE '09*-----308 Western Ave Aspenwall Ia

- *McKeever, William CE '98 MAGasInst MIES 34th & Essey St
1830 Rittenhouse Sq Philadelphia Pa
- McKinstry, Ross W CE '18 JASCE 5131 Kimbark Ave Chi-
[eago Ill
- *McKown, Howard P CE '09-----4139 Franklin Road
Construction Engineer Carbon Steel Co Pittsburgh Pa
- McLeod, Donald F CE '07-----MASCE MSPEE
Prof Mun Engrg Univ of Miss University Miss
- McLoughlin, A Vincent CE '20 54 Liberty Ave New Rochelle
[N Y
- *McMath, Neil C CE '14-----1037 Iroquois Ave Detroit Mich
Mgr Buhl Stamping Co Walkerville Ont Can
- *McMillin, Edwin R CE '17 203 Savannah Ave Wilkesburg Pa
Engineer Pittsburgh Bridge & Iron Works Rochester N Y
- McNair, George H S CE '18---719 W 180th St New York City
N Y Tel Co 15 Dey St
- McPherson, Kenneth W CE '09-----Castle Shannon Pa
Engineer Pittsburgh Railway Co
- Ma, Yu Chi CE '19-----Liau-a-au Amoy China
San Engr West Palm Beach Fla
- *Maas, Charles L CE '15-----5848 Florence Ave Phila Pa
Prod Engr United Gas Improvement Co Broad & Arch Sts
- Macedo, Jose B CE '17 Avendo Rio Branco 60 Rio de Janeiro
Engineer for Coal Mining Co [Brazil
- Mack, Francis A J CE '12-----203 Amherst Ave Syracuse N Y
- *Mack, Harry E CE '01-----Box 2 Marathon N Y
Engr and Draftsman American Road Machinery Co Inc
- Maekenzie, Donald A CE '17 S Lexington Ave WhitePlains N Y
- Mackintosh, William CE '96 1213 W 16th St Oklahoma City
Mackintosh Walton Co Cons Engrs State National [Okla
Bank Bldg
- *Macleish, Gordon G CE '12---Box 24-A R F D LaHabra Calif
Engineer LaHabra Heights Co
- Macpherson, David J CE '77 1120 Atchison St Pasadena Calif
Retired
- Macy, Frank H CE '10-----26 Eighth St Hudson N Y
Asst Civil Engr N Y State Conservation Comm Albany N Y
- *Macy, Paul CE '13-----43 Raines Park Rochester N Y
Repr Barrett Co for W N Y Box 34 Brighton Sta
- Madden, William Francis CE '21---16 Hubbard St Cortland N Y
Jr Asst Engr N Y State Hwy Dept Hornell N Y
- Madigan, Francis W CE '07 460 Maplewood Ave Rochester N Y
Assistant Engineer Dept State Engineer and Surveyor
- *Magsaysay, Ambrosio CE '09---421 Calle Paz Pao Manila P I
Asst Mgr Yango Steamship Co St Muelle Industria
- *Maher, Paul L CE '13---MSIndE 1217 Kemble St Utica N Y
With Emerson Co of New York Box 208 Elwood Ind
- Mahoney, Lee C AB CE '12-----3135 Pacific Ave
Estm Engr Bldg Constr 1011 Bush St San Francisco Calif
- Maier, Edward L CE '21 2206 Minn Ave S E Washington D C
- Mallery, Clarence S CE '89-----412 Front St Owego N Y
Pres Binghamton Bridge Co 1104 Press Bldg Binghamton NY
- Mallery, John S CE '16-----412 Front St Owego N Y
Ch Engr Binghamton Bridge Co 1104 Press Bldg Binghamton
N Y
- *Mallison, Charles H CE '07-----1012 High St Pottstown Pa
Acting Mgr of Erection McClintie-Marshall Constr Co
- *Malone, George E CE '03-----521 No Eleventh St Reading Pa
- Maltby, Albert E CE '76 LLD Phd MlistSWPa 507 Stewart
Teacher in Collège Grove City Pa [Ave
- Mambrert, Stephen B CE '08 487 Berkeley Ave So Orange N J
Vice Pres & Finan Exec Thos A Edison Co E Orange N J
- Manchester, Wilbur O CE '20-----Nassau N Y
- Mann, Joseph S BS CE '12-----Fairfield N C
Chf Engr Coastal Land & Devp Co New Holland N C
- Mann, Louis M CE '77-----MWeSE Milwaukee Wis
Assistant Engineer U S Engineer Office Federal Bldg
- Mann, Matthew D Jr PhB CE '08---625 Locust St Roselle N J
Supt Chem Prod Div Standard Oil Co Elizabeth N J
- Mann, Roberts J CE '13 MCE '14---629 Moss Ave Peoria Ill
- Mao, Thomson MCE '17 2031 Monongahela Ave Iwissvale Pa
Asst Principal Tangshan Engrg Coll Tangshan China
- Marks, A Lester CE '15-----c/o Constr Q M Honolulu T H
Engineer Construction Q M Schofield Barracks T H
- *Marsh, Clarence W CE '94 MAChE MACHS MAES Cos Cob
Cons Engr 101 Park Ave New York City [Greenwich Conn
- Marston, Anson CE '89-----MASCE MWeSE Ames Ia
Dean of Engrg Iowa State Coll Mem Iowa State Hwy Comm
- Martens, James H CE '21-----Shrub Oak N Y
- Martin, Charles E CE '21---150 Selye Terrace Rochester N Y
With Public Service Gas Co of New Jersey
- Martin, J Ward CE '19-----3138 Sheridan Road Chicago Ill
Mem Firm Morgan & Martin Drilling Contrs Sapulpa Okla
- *Martin, Thomas Jr CE '09---112 Powelton Ave Lansdowne Pa
Philadelphia Navy Yard
- Martin, William F MCE '06---AMASCE 1054 Mariposa Ave
Asst Prof Mech Engrg Univ Calif Cons Engr Berkeley Calif
- Marvin, Ralph E CE '03 c/o Dr. F. L. Marvin Muskegon Mich
Civil Engrg & Mining 306 London Bldg Vancouver B C Can
- *Marx, Charles D CE '78---MASCE MWeSE 357 Kingsley Ave
Prof C E Leland Stanford Univ Cons Engr Palo Alto Calif
- Marx, Erwin CE '00-----2562 Observatory Ave Cincinnati O
Sales Manager The G A Gray Co Gest & Depot Sts
- Masters, Frank H AB CE '04 MAREA MWeSE 207 Youngs Ave
Assistant Chief Engineer E J & E Ry Co Joliet Ill
- *Mauer, William J CE '09-----MAAE 936 Lawrence Ave
Assistant Sales Manager American Radiator Co Chicago Ill
- Maxeiner, Carl A CE '18-----486 Yates St Albany N Y
- *Maxon, Paul J CE '13-----50 Palisade Ave Bogota N J
Engineer National City Bank 55 Wall St N Y C
- Maxwell, Donald P CE '07-----1004 Baltimore Ave Normant Pa
Concrete Engr Aluminum Co Amer Oliver Bldg Pittsburgh Pa
- Maxwell, Frank A CE '78 MCE '79-----Georgetown Colo
Mining Engineer
- Mayhew, Robert CE '94---2 Daggett Terrace Schenectady N Y
Machinist
- Maynard, Henry W CE '07 MNACA 3089 Broadway N Y C
Cost Acct Scovell Wellington Co Pub Accts 27 William St
- Mayo, Geoffrey W CE '07-----AMASCE Smethport Pa
Sen Hwy Bridge Engr 501 Wheat Bldg Ft Worth Tex
- Mead, Daniel W CE '84-----MASCE MASME MAIConSE
Cons Engr & Prof Hyd San Engrg Univ Wis Madison Wis
- *Mead, Robert G 2nd CE '17-----Ossining N Y
Prod Dept Werthington Pump & Machinery Corp
- Mead, Theodore L CE '77-----MPhilaAcadNSc Oviedo Fla
Horticulturist
- Meehan, John W CE '87-----MPNWSE Mt Vernon Wash
City Engineer
- Meikle, A Craig CE '15-----3115 Clifton Ave Baltimore Md
Res Engr Norton Bird & Whitman 616 Munsey Bldg
- *Meissner, Charles R CE '12---45 Lenox Road Brooklyn N Y
Exp Engr Seaboard By-Product Coke Co Jersey City N J
- *Mellen, Arthur W Jr CE '17-----2676 Morris Ave N Y C
Raymond Concrete Pile Co 140 Cedar St
- Mellor, Alfred R CE '12---52 Bay State Ave W Somerville Mass
Asst Engr Comm on Pub Works State House Boston Mass
- Menefee, Ferdinand N BS in CE CE '10 AMASCE Ann Arbor
Prof Univ of Mich V Pres United Engrg Corp Detroit [Mich
Mich
- Mengers, Charles A CE '15 MECIB 3145 S Atlanta Rd Camden
Designer U G I Philadelphia Pa [N J
- Menocal, Mario G CE '88-----Chaparra Oriente Cuba
- *Merrill, Thomas D CE '78---2625 Greysolon Rd Duluth Minn
Lumber Dealer 210 First National Bldg
- *Mershon, Edward J CE '14-----27 Spring St Brockport N Y
Sales Engr Pittsburgh-Des Moines Steel Co 807 Curry Bldg
Pittsburgh Pa
- Meston, Robert S CE '16-----501 Clara Ave St Louis Mo
- Metzger, Harold N CE '07---166 Lancaster Ave Buffalo N Y
Member Metzger Construction Co 676 Genesee St
- Meyer, August B CE '14-----759 E 17th St Brooklyn N Y
- Meyer, Henry R J BS MS CE MCE '14---MAAE 826 1st Ave
City Engineer Box 1524 Havre Mont
- *Meyers, Clarence W CE '02 MCE '03 314 Riverside Drive NYC
- Michaelson, Joseph CE '92---1234 Girard St N W Wash D C
Expert Aid Bureau Yards and Docks Navy Dept
- Michelson, Benjamin C CE '19---1870 Wyoming Ave Wash D C
- Middleton, Cornelius W CE '16---315 Clinton Ave Brooklyn N Y
Engineer Babcock & Wilcox Co 85 Liberty St N Y C
- Mildon, Reginald B CE '00-----Lansdowne Pa
Asst to Vice Pres Westinghouse Electric Mfg Co Lester Pa
- Miles, Hamilton V CE '08-----Cornell Heights Ithaca N Y
Manager Wisteria Tea Garden
- *Milban, David N CE '15---AMASCE MASTM Sodus N Y
Asst Constr Engr Sinclair Refining Co Coffeyville Kan
- Miller, Bruce McC CE '03---800 No Canal St Pittsburgh Pa
Draftsman Jones & Laughlin Steel Co
- *Miller, George CE '17-----54 Black Rock Ave
Civil Engr Hwy Dept Baldwin Locomotive Works Phila Pa
- Miller, Granbery CE '13-----4500 Euclid Avenue Cleveland O
General Contractor
- *Miller, Harold G CE '17-----512 Greenwich St Reading Pa
Vanity Fair Silk Mills
- *Miller, John H CE '12-----238 Argyle Road Brooklyn N Y
- Miner, James H CE '00---MAAE Bellair Dr Dobbs Ferry N Y
Estimator Dwight P Robinson & Co 125 E 46 St N Y C
- Minnix, Allen C CE '15-----1820 K St Washington D C
Builder
- *Mirick, Alfred S CE '10---AMASCE 1421 G St Lincoln Neb
Chief Constr Engr Dept Pub Wks State of Neb

- Miscall, Leonard CE '19--MAAE 845 Clinton Ave Albany N Y
Instr Descriptive Geometry Univ of Illinois Urbana Ill
- Mitchell, Louis A CE '02--MASCE MAREA Anderson Ind
Engineer M of W Union Traction Co of Ind 647 Union Bldg
- Modjeski, Charles E J CE '21 222 So Michigan Ave Chicago Ill
- *Moeller, Henry L CE '07 AMASCE 20 Bellevue Ave Wee-
Chf Engr Martini & Hueneke Co of Amer [hawken N J
1201 Hudson St Hoboken N J
- Mollard, Charles E CE '01--AMASCE Skaneateles N Y
Str Engr American Bridge Co Pittsburgh Pa
- Monaghan, Thomas A CE '17--460 W 142d St N Y C
- Monge, M Arturo CE '04--MNatSCE Buenos Aires Arg Rep
Gen Insp National Comm Bridges & Roads
- *Monk, Percy S CE '10--MAAE AMASCE 608 So Dallas Ave
Asst Engr Benno Janssen 802 Century Bldg Pittsburgh Pa
- Montgomery, James J CE '03 33d St & Haverford Ave Phila Pa
- Moonaw, Dalton BS CE '09 MASCE MCIES 1121 Blaine Ave
Engr Mgr for Seaman Constr Co S Bend Ind
- Moore, A Kenneth P CE '17--209 Walnut St Montclair N J
Sprague Electric Works Bloomfield N J
- *Moore, Charles B CE '16--MAAE Box 324 Marion Ala
- *Moore, Egbert J CE '99--MASCE 397 N Brdy Yonkers N Y
Vice-Pres Turner Constr Co 244 Madison Ave N Y C
- *Moore, Frank C CE '92--9130 115th St Richmond Hill L I
Civil Engr American Bridge Co 30 Church St N Y C
- *More, Charles C MCE '99--AMASCE 4545 5th Av N E
Prof C E & Head of Dept Univ of Wash Seattle Wash
- Morgan, J Holloway CE '13 MAAE 976 Woodcrest Ave N Y C
Statistical Expert 1361 Irving St N W Washington D C
- *Morgans, Howard K CE '07 760 Commonwealth Ave Detroit
Superintendent for Builder [Mich
- Morris, Garfield T CE '04 MAAE 319 Sta Clara Ave Alameda
Off Engr Bur Val I C C 731 Wells Fargo Bldg [Calif
San Francisco Calif
- *Morris, Phillip CE '12--1609 W Venango St Philadelphia Pa
Gen Mgr Workingmen Homes Co Passaic N J
- Morris, W Harley CE '09--MBRECI Port Washington N Y
Asst Engr Transit Constr Comm 49 Lafayette St N Y C
- Morton, John W CE '19--200 A St S E Washington D C
- *Mosher, Sidney W CE '17--Poplar Ridge N Y
Grad Student Cornell Univ Ithaca N Y
- Moss, Berkeley N CE '93 6605 Franklin Ave Hollywood Calif
Civil Engineering and Land Developing
- *Mossrop, Alfred M CE '85--MASCE Mlr&SI (London)
Cons Engr 36 E Boulevard Rochester N Y
- *Mueden, George F CE '05--
Asst Engr N Y State Pub Service Comm 1st Dist N Y C
- Muench, William O Jr CE '12--5221 Chester Ave Phila Pa
- Mulhearn, Lawrence J CE '13--Bronxville N Y
c/o N Y C R R
- Mullen, Frederick B CE '17--448 Hillside Ave Jamaica N Y
Butler Bldg
- *Muller, Leslie CE '96--AMASCE Shelton Wash
Mulliken, Alfred CE '18 c/o Mrs. Zell The Walbert No Charles
Asst Engr N Y S Dept of Health Albany N Y [St Balt Md
- Munisteri, Philip CE '20--78 Starr St Brooklyn N Y
- *Munn, Harvey T CE '13 AMASCE MAAE 1833 S St N W
Hyd Engr Bd of Fire Underwriters [Wash D C
76 Williams St N Y C
- Munnikhuysen, Walter F CE '15--Bel Air Md
Field Engineer H Koppers Co Sault Ste Marie Ont Can
- Munos, José del C CE '91--Rivas Niaragua C A
Pres of Board of Public Instruction
- Murphy, Edward C CE '84 MS MCE '00--MASCE Napa Calif
Hydraulic Engineer U S Geological Survey
- Murray, Clare D CE '07--AMASCE DeRuyter N Y
c/o Southern Import Co DeWitt Ark
- Mussi, Angelo P CE '08 R D 3 1909 E Main St Rochester N Y
Asst Engr Barge Canal Office 43 Triangle Bldg
- Nagle, James C MCE '93--MASCE MAAE 3 College Sta Tex
Prof C E Dean Engrg & Dir Engrg Exp Sta A & M Coll Tex
- Nagler, Salyg CE '18--224 Ave B New York City
Jun Engr Ford Bacon & Davis 577 W 177th St
- *Nakamoto, Goichi CE '17--Hilo Hawaii T H
Asst Engr with Pacific Engrg Co Honolulu T H
- Namba, Tsunero MCE '88--MJSCE Aomori City Japan
Chief Engr Aomori Harbor Improvement Chikkojimusho
- Names, Sewell CE '12--MAAE 194 Newfield St Buffalo N Y
Supt Const Acheson Graphite Co Niagara Falls N Y
- Nash, Jack T CE '16--1604 Eighth Ave Fort Worth Tex
Chief Office Engr Henry Evald Elrod Co Dallas Tex
- *Natanson, Walter E CE '13--132 Hampden St Chicopee Mass
c/o American Consul Barranquilla Colombia S A
- Neafie, William O CE '20--1833 Mt Vernon St Phila Pa
Res Mgr Wooster Thomas & Co Securities
- Needle, Joseph CE '20--547 King St Charleston S C
- Nelson, Elbert J CE '07--P O Box 505 Chickasaw Branch
Engineer Chickasaw Shipbuilding Co Mobile Ala
- Nelson, Harry M CE '08--E Ryegate Vt
Job Engineering A I S C Hlog Island Pa
- Nelson, John I CE '12 c/o F S Denneen 9716 No Blvd Cleveland
[Ohio
- Nesbit, Edgar D BS in CE CE '12--Jonesboro Ind
County Surveyor of Jasper Co Rensselaer Ind
- Nesbit, Elmer C BS in CE CE '12--Jonesboro Ind
Engineer Smith & Thompson Contractors Witoka Minn
- Nethercot, David G CE '20--518 Cherry St Winetka Ill
- Neu, Edgar W CE '21--1081 Jefferson St Buffalo N Y
- *Neumaier, Martin CE '16--1417 Grand Concourse N Y C
Civil Engineer War Dept Columbia S C
- Neville, Colon W J BS MCE '01--MASCE 2226 Canal St
Cons Engr 631 No Alexander New Orleans La
- *Newbold, Thomas T CE '14--202 Macon St Brooklyn N Y
Engr Irwin & Leighton Box 166 Lakehurst N J
- *Newkirk, Arthur D CE '15 MAAE 415 E Third St Jacksonville
Asst Engr Georgia State Hwy Dept. Natl Bank Bldg [Fla
Savannah Ga
- Newman, Thomas S CE '03 406 Lexington St Auburndale Mass
- *Nickerson, G Lloyd CE '14 MAAE Box 262 Middletown N Y
Highway Engineer P O Box 104 Poughkeepsie N Y
- *Niemeier, Carl H CE '91 MAREA 206 Corshohocken Ave
Asst Chief Engr East Region Pa R R [Cymryd Pa
Penn Station Williamsport Pa
- *Nisenson, Amos O CE '10--5 Hillside Ave Newark N J
Civil Engineer & Surveyor 9-15 Clinton St
- Nitchie, Francis R AB '06 CE '10--Seat Pleasant Md
Reitor, Addison Parish Diocese of Washington
- Noble, Henry J CE '09--325 Penn St Pittsfield Mass
- *Norton, George H CE '87--MASCE 62 Tillinghast Place
City Engineer 20 Municipal Bldg Buffalo N Y
- November, Nathan CE '19--111 India St Brooklyn N Y
With U S Coast & Geodetic Survey Camp Porpoise Me
- Nussbaum, Walter E CE '15--128 S First St Lehighton Pa
Mun Engr Palmer Land Co Palmerton Pa
- Nye, Algernon S CE '88--351 W 51st St N Y C
- Ober, John L CE '16--143 Abercom St Savannah Ga
Mem Firm Carson Construction Co Box 180
- O'Brien, Earl F CE '20--127 Freeman Ave Solvay N Y
- O'Brien James B CE '11--41 So Second St Steifton Pa
Civil Engr Central Hershey Prov Havana Cuba
- O'Connor, Bernard CE '13--168 Ash St Watertown N Y
Manager Standard Oil Co Sacramento Calif
- *O'Connor, F Barnard CE '13 AMASCE 1 Lexington Ave NYC
Asst Chf Engr Alphons Custodis Chim Const Co Bennett Bldg
- Odessa, Herman P CE '21--105 Stockton St Brooklyn N Y
c/o C&GS Washington D C
- *Ogden, Henry N CE '89 MASCE 614 University Ave Ithaca
Prof San Engrg School of Civil Engrg Cornell Univ [N Y
Mem Pub Health Council N Y State
- Ogelsby, Hart D CE '12 MESPa 31 So Front St Harrisburg Pa
Engineer State Highway Dept Erie Pa
- Ogier, George R CE '08--928 Detroit St Denver Colo
Civil Engineer
- Ohrt, Frederick CE '11--AMASCE 779 D Lunalilo Terr
City & County Engineer Room 20
Kapiolani Bldg Honolulu T H
- Olds, Thomas H BS CE '07 AMASCE 2347 Elm St Denver Col
Civil & Hydr Engineer First National Bank Bldg
- O'Leary, James H CE '19--23 Wall St North Adams Mass
N Y State Hwy Dept Watertown N Y
- Olin, Franklin W CE '86--MASME 1128 State St Alton Ill
Pres West Equit & Egyptian Powder Cos & West Cartridge Co
- Ollason, Peter CE '02--Watsonville Calif
- *Olmstead, Charles H CE '16 MAAE 327 7th Ave N Nashville
District Engineer State Hwy Dept [Tenn
- Olney, Willard W CE '79--Bay Minnette Ala
Locating Engineer
- Onstott, Virgil S CE '21--Saltsburg Pa
- O'Reilly, Francis S CE '09--619 Tracy St Utica N Y
25 Nassau St New York City
- O'Rourke, Bernard J CE '10--AMASCE 430 Walnut St
Engr & Contr O'Rourke Bros Philadelphia Pa
- O'Rourke, Charles E CE '17--450 St Nicholas Ave N Y C
Instructor Bridge Engrg Cornell Univ Ithaca N Y
- O'Rourke, Frank H CE '12 AMASCE 815 Madison St Syracuse
Engr & Contr O'Rourke Bros 430 Walnut St Phila Pa [N Y
- Ormsby, Frank W CE '81--46 W Cayuga St Oswego N Y
Civil Engineer West First St
- Osborne, Alfred B CE '03--Oneida N Y
Engineer with Larkin Co 31 Remoleno St Buffalo N Y
- Ostrom, John N CE '77--MASCE MAREA
Cons Bridge Engineer East Randolph N Y

- Otero, A Lucchetti (See Lucchetti)
- *Ourand, William R CE '09-----4205 Eastway Toldeo O
Willys-Overland Co
- Owen, Elijah H PHB CE '99-----AMASCE 390 Lawrence Ave
Supt Const H M Lane Co Owen Bldg Detroit Mich
- Owens, Harold V CE '05-----AMASCE 127 Thomas St Utica N Y
See and Treas Dale Engrg Co Genl Contrs
- Paaswell, George CE '08-----MASCE 212 W Fordham Rd
Seet Engr N Y State Public Service Comm 1st Dist N Y C
- *Pacello, Vincent J CE '17-----54 Travis Ave Port Chester N Y
- Paekard, Daniel B AB CE '04-----219 So Coit St Florence S C
Asst Val Engr Atlantic Coast Line R R
- Páez, José CE MCE '13-----MPhIE&A Malabon Rizal P I
Director Bureau of Public Works Manila P I
- Page, Blinn S CE '14-----1530 Burlingame Ave Detroit Mich
Salesman Carnegie Steel Co 1815 Ford Bldg
- Page, William H CE '83-----1556 W Collin St Corsicana Tex
Engineering and Farming
- Palacio, Felipe G BS CE '09 4 Calle de Luecina Mexico City
[Mex]
- *Palmer, Marshall B CE '95-----AMASCE 104 Amherst Ave
Cons Engr City Engrs Office Syracuse N Y
- Palmer, Ray S CE '97 DDS 41 St Pauls Place Brooklyn N Y
Dentist
- Pan, Chu-Hung MCE '21-----Wuehow Kwangsi China
- Panton, Edward C CE '14-----Care L C Bement Ithaca N Y
Asst Engr U S Reclamation Service King Hill Idaho
- Parker, Gilbert E CE '16-----820 5th Ave Cedar Rapids Ia
Capt U S A 49th Inf Ft Snelling Minn
- *Parkhurst, Roger W CE '13 AMASCE 22 S Portland Ave
e/o Barber Asphalt Paving Co 233 [Brooklyn N Y
Broadway N Y C]
- Parmenter, Richard CE '17-----Box 366 Geneva N Y
See Société Anonyme des Automobiles (Pierce Arrow) Paris
France
- Parsons, Herbert CE '91-----635 W 62d St Chicago Ill
Civil Engineer
- Paterson, Charles J CE '07-----3060 Coleridge Rd Cleveland
President The Paterson Leitch Co Cleveland O [Heights O]
- *Patriek, Arthur S CE '15-----109 Hobart St Utica N Y
With The Texas Oil Co 509 E Fifth St Brooklyn N Y
- Patten, Harry A CE '07-----New Bern N C
Farmer
- Patten, William E Jr CE '11 401 Conklin Ave Binghamton N Y
Prof Civil Engrg Nan Yang Univ 702 Am P O Shanghai Ch
- *Patterson, Harold J CE '11-----1070 Carroll St Brooklyn N Y
Asst Engr Foundation Co West Hartford Conn
- *Paulus, Roy CE '08-----342 State St Flushing N Y
Paulus-Ullman Printing Corp 295 Lafayette St N Y C
- Paz, Louis CE '93-----Pinalejo Honduras C A
- Pearse, Henry B CE '13-----10801 Earle Ave Cleveland O
Real Estate Development and Building
- *Pearson, Edward J CE '83-----MASCE MAREA
President N Y N H & H R R Railroad Bldg New Haven Conn
- *Peebles, Stuart L CE '11-----9 Essex St Orange N J
Asst to Mgr Atlantic Gulf & Pacific Co N Y C
- Pei, I-Hsiang MCE '20 MSSCh MESCh Hung St Luehowfu
[Anhui China]
- Pendergrass, Robert A CE '00 MCE '01 MASCE 409 Pembroke
Asst Gen Mgr McClintie-Marshall Co [Rd Cynwyd Pa
Philadelphia Pa]
- Pendleton, Claude M CE '18-----Port Dickenson N Y
Instructor School of Civil Engrg Cornell Univ Ithaca N Y
- Penfield, George W CE '00-----MCnSCE New Hartford Conn
Asst Engr Board of Water Commrs Hartford Conn
- Pennywitt, John CE '15-----419 Lloyd St Pittsburgh Pa
- Perkins, Albert H CE '93 MCE '94 MASCE MALbSCE Albany
Div Eng Chief Division Waters N Y Conservation Comm [NY]
- *Perkins, Frank K CE '12-----110 So Tenth Ave Mt Vernon N Y
- *Perkins, Nelson S CE '15-----110 So Tenth Ave Mt Vernon N Y
- Perlman, David CE '19 608 Louisiana Ave N W Washington
U S Coast & Geodetic Survey [D C]
- Perry, Arthur F Jr CE '16-----1202 Riverside Ave Jacksonville
[Fla]
- *Pesant, Louis CE '15-----MCuSE Box 410 Havana Cuba
Str Steel Dept Krajenski-Pesant Corporation
- Philipson, Robert A CE '19 MAAE 175 Main St Ossining N Y
Civil Engineer Seelye & Fraser 101 Park Ave N Y C
- Phillips, Cushing CE '17-----1150 84th St Brooklyn N Y
Lieut (J G) CEC USN Annapolis Md
- *Phillips, Frederick CE '92-----Peterborough N H
- Phillips, John M CE '14 AMASCE 509 Laurel Ave Bridgeport
Resident Engineer [Conn]
- *Philp, Burk K CE '10 MAAE LMEC Box 438 E Lansing Mich
Asst Prof Civil Engrg Michigan Agricultural College
- Picker, David H CE '13-----554 Seventh St Brooklyn N Y
Sales Engr D & M Patents Co 166 Montague St
- *Piddian, Joseph CE '11-----1172 President St Brooklyn N Y
Supt Constr E Parkway & New York Ave
- *Pierce, George C CE '09 Care Lusk & Thompson Chattanooga
Atlantic National Bank Bldg Jacksonville Fla [Tenn]
- Pierce, Leslie E CE '16-----JASCE 129 Grove St Stamford Conn
- Pierce, Orrin J CE '13-----Woreester N Y
Junior Asst Engr N Y State Barge Canal Rochester N Y
- *Pierce, Paul L BS CE '06 MASCE Am Trust Bldg Birming-
[ham Ala]
- *Piersol, John A CE '17-----612 Meadow Ave Charleroi Pa
With C H Hurd Constr Engr Indianapolis Ind
- *Pineo, Charles N CE '03-----1143 Lexington Ave N Y C
Sales Engr Liberty Steel Products Co Woolworth Bldg
- Pino, Farrera Francisco Jr CE '05-----211 W State St Ithaca N Y
Hotel Continental Guatemala City Guatemala
- Piper, William E BS CE '09 2209 Church St Wilmington Del
Project Engineer du Pont Engrg Co
- *Pistor, George E J CE '01 MASCE 55 Elstun Rd Upper Mont-
Constr Engr Hay Foundry & Iron Works N Y C [clair N J]
- Pitner, Harold L CE '13-----786 Park Ave Weehawken N J
Engr Way & Structures N Y & Harlem R R Co N Y C
- Place, Arthur H CE '94-----Blissfield Mich
Engr Bureau of Govt Research Detroit Mich
- Ploss, Paul CE '11-----520 Park Road Ambridge Pa
Ford Motor Co Detroit Mich
- Polaek, Waldemar CE '21-----201 E 33d St New York City
- Polak, Henry B CE '11-----279 Magnolia Ave Jersey City N J
H B Polak Mfg Co Elect Appliances 10-12 Cook St
- Pologe, Benjamin CE '15-----1253 St Nicholas Ave N Y C
Field Engineer The Foundation Co 233 Broadway
- Ponee de Leon, Felipe AB CE '10 MCuSE San Miguel 69 D
Civil Engineer [Havana Cuba]
- Pond, Ben L CE '20-----339 E Market St Stockton Calif
- *Pons, Francisco CE '09-----MACPR MSIPR Santuree P R
Contracting Engineer
- *Poole, Ruble I BE CE '10-----AMASCE Randleman N C
Box 746 Raleigh N C
- *Pope, Herbert B CE '14 209 Washington Ave Haddonfield N J
- Porrata-Doria, Francisco L CE '13-----35 Marina St Ponee P R
Civil Engineer 3 Mayor St Pvt Office
- Porter, Harry F CE '05 MAConeI 80 Harral Ave Bridgeport
[Conn]
- Porter, Percy W CE '07-----City Engrs Off Los Angeles Calif
Deputy City Engr of Los Angeles Wilmington Calif
- *Poss, Victor H CE '92 MASCE 2929 Russell St Berkeley Calif
Gen Mgr San Francisco Shipbuilding Co Oakland Calif
- *Potts, Clyde CE '01-----MASCE 4 Farragut Pl Morristown N Y
Civil & Sanitary Engineer 30 Church St New York City
- Powell, Charles U CE '98 MASCE Bdwy & Sanford Ave Flush-
Engr Top Bur Bor Queens Long Island City N Y [ing N Y]
- Powell, George W CE '85-----93 Gorham St Canandaigua N Y
County Engineer
- *Powell, Hugh A CE '12-----1910 S 16th Ave Birmingham Ala
Sales Engr 409 Woodward Bldg
- Powell, Ralph W CE '14-----R D I Ionia Mich
Teacher Yale Mission Changsha Hunan China
- Pratt, Avery J CE '09-----1246 Hertel Ave Buffalo N Y
Gen Mgr R S McMannus Steel Constr Co
- Pratt, Joshua D CE '15-----2048 Nunam Ave Honolulu T H
Bureau of Census
- Pratt, Roy E CE '21-----36 Elm St Franklinville N Y
- Pregler, Anton A CE '21-----859 Main St Stamford Conn
- Prentice, Thomas H CE '17-----159 Main St Southington Conn
154 Edgewood St Hartford Conn
- Preston, John O CE '17-----
Mgr Prod Order Div Circ Dept Curtis Pub Co Philadelphia Pa
- Prettyman, J Edward CE '19-----Seaford Del
Del State Highway Dept Greenwood Del
- Preece, W Mitchell CE '11-----2703 Roslyn Ave Baltimore Md
Pres and Genl Mgr the Preece Construction Co
- Priester, Oscar F CE '17-----2516 Fulton Ave Davenport Ia
Priester Construction Co 1006 Kahl Bldg
- *Priester, Walter A CE '15-----811 W Seventh St Davenport Ia
Priester Construction Co 1006 Kahl Bldg
- Proctor, Ralph F CE '01-----MASCE 151 W Lanvale St
Chief Engineer Maryland Casualty Co Baltimore Md
- *Purell, Stewart CE '01-----AMASCE 1600 Hilton St
Div Engr of Highways City Hall Baltimore Md
- Purdy, George L CE '16-----401 Laurens St Olean N Y
Civil Engineer Vacuum Oil Co
- *Purdy, Samuel M CE '96-----MASCE 470 Third St Brooklyn N Y
J G White Engrg Corp 43 Exchange Pl N Y C
- *Queral, Raymond CE '13-----MCuSE Box 1 Puerto Padre Cuba
Engineer & Contractor Manati Oriente Cuba

- Quinn, John J Jr CE '17-----495 Eighth St Brooklyn N Y
General Motors Export Co Broadway & 57th St N Y C
- Quinones, S CE '21-----Rio Piedras P R
Dept Interior San Juan P R
- Quinton, Alfred B Jr CE '12-----1632 S St N W Washington D C
Major U S A Ord Dept 130 Lake Ave Newton Center Mass
- Quisumbing, Emilio AB CE '08 MPIE&A 1020 So Andres St
Civil Engr Irrigation Div Bur Public Works Manila P I
- *Radford, Charles F CE '15-----Hermansville Mich
Radneziner, Joseph CE '21-----12 Paul St. Rochester N Y
N Y State Hwy Dept Hornell N Y
- Ragland, Edmond U BS CE '14 228 W Fisher St Salisbury N C
- Ramag, William C II CE '10-----507 West Ave Mt Carmel Pa
Asst Chief Engr The Brier Hill Steel Co Youngstown O
- Ramirez, Reinaldo CE '16-----Cabo-Rojo P R
Civil Engineer
- Ramsay, James H BSc CE '13-----75 Hogarth St Toronto Can
Randolph, Alfred M CE '14-----8 E Preston St Baltimore Md
Bartlett Hayward Co
- Rapp, George W Jr CE '16 MAAE 1337 Chapel St Cincinnati O
Engineering Dept Trailmobile Co
- Rasbach, D Bennett CE '12-----441 No Prospect St Herkimer N Y
Jun Mem D C & C L Wood Civil Engrs and Surveyors
- Rasch, Charles J CE '10-----2846 Guilford Ave Baltimore Md
Asst Res Engr U S Shipping Board Sparrows Point Md
- Rayfield, Frederick H CE '15-----938 Prospect Place Ashland Ky
Engineer Kentucky Solvay Coke Co
- Raymond, Arthur A CE '15-----MAAE 136 Norwalk Ave Buffalo
Dist Engr 304 Security Bldg Kansas City Mo [N Y
- Raymond, Charles W CE '76 MCE '78-----MASCE 811 H St
Min Engr 224 Oehsner Bldg Sacramento Calif
- *Raynor, Leroy P CE '17-----Riverhead N Y
Jun H & G Engineer U S Coast & Geod Survey Manila P I
- Read, Jesse E CE '81-----448 Kosciusko St Brooklyn N Y
Asst Engr Finance Dept Municipal Bldg N Y C
- Read, Willett W CE '88-----714 Chilton Ave Niagara Falls N Y
Pres Read Coddington Engrg Co 238 Portage Road
- Reardon, Nye B CE '05-----466 Guy St Montreal Can
Asst Engr of Buildings Canadian Pacific Ry
- Reck, William M CE '14-----416 54th St Brooklyn N Y
Dist Engr Concrete Steel Co Union Bldg Syracuse
- Redwood, John P CE '17-----Bay Pond N Y
Civ Engr 30 Rockland St Malone N Y
- Reed, James W CE '83-----509 W 121st St N Y C
Asst Engr Board of Estimate & Apportionment Mun Bldg
- Reese, Charles E CE '20-----249 E Walnut St Westfield N J
- Regan, Francis A CE '21-----966 74th St Brooklyn N Y
- Regula, Albert S CE '14-----168 Clinton Ave Jersey City N J
Dist Chief Engr Liberty Ins Co 30 E 42d St N Y C
- Reilly, Albert R CE '14-----136 Park Ave Watertown N Y
e/o Eastman Kodak Co Kodak Park Rochester N Y
- Reiter, Arthur P CE '10-----3 So Grove St E Orange N J
Life Ins Metropolitan Life Insurance Co
- Reitz, Chester N CE '05-----MASCE MASTM 3517 E Olive St
Pae Coast Mgr Portland Cement Assn Seattle Wash
- Rekate, George H CE '07-----Lancaster N Y
- Rensen, Peter CE '12-----MAAE 605 So Grant Ave
Asst Squad Boss Concrete Engrg E I Dupont Co Wilmington Del
- Remy, Jorge F EM CE '07-----Pisco Peru
Manager Pisco-Ica R R
- Roppert, Charles M CE '04-----MASCE 6324 Bartlett St
Chief City Engineer Pittsburgh Pa
- Requardt, Gustave J CE '09-----MASCE 704 Cathedral St
Civil & San Engr Baltimore Md
- Reynolds, William W CE '06-----255 Sidney Ave Mt Vernon N Y
- Rhodes, Leland S CE '11-----Lebanon Pa
Asst Prof C E Pa State Coll State College Pa
- Rhodes, O Lynn CE '09-----222 W Madison St Baltimore Md
- Rhynus, Clarence P CE '11-----JASCE MAPHA MAWWA
[Claircrest Pa
- Rice, John II CE '07-----194 Main St North Adams Mass
Contractor Buffalo Wyo
- Rich, Melvin S CE '05-----MASCE 1448 Harvard St N W
Cons Str Engr 1410 H St N W Washington D C
- Rickard, Grover E AB CE '16-----MAAE 32 S Rhembert St
Engr Analyst Artesian Water Dept [Memphis Tenn
- Rickard, LeRoy S CE '06-----MAAE Cobleskill N Y
Asst Engr N Y S Comm of Highways
- Rider, Arthur B CE '98-----Rhineland Wis
Superintendent Construction U S Public Buildings
- Ridgway, Herbert CE '15-----AMASCE 819 Haddon Ave Camden
Asst Engr Am Bridge Co 30 Church St N Y C [N J
- Riegel, Ross M CE '04-----MASCE New Cumberland Pa
- Riess, Osear BE CE '09 MLaES 1423 Milan St New Orleans La
Civil Engineer & Contractor 503 Hibernia Bldg
- Riker, I Russell CE '15-----MAPHA MNJSA Lawrenceville N J
San Engr State House Trenton N J
- Riley, John II T CE '09-----262 Remsen St Cohoes N Y
414 No Third St Philadelphia Pa
- Rindsfoos, Charles S CE '06-----AMASCE 126 E 19th St N Y C
Civil Engr Rm 916 30 E 42d St
- Ripley, John W CE '93-----MASCE 250 State St Flushing N Y
Vice-Pres & Treas The Robbins-Ripley Co N Y C
- Ritter, Gilbert P CE '97-----1326 Fairmont St N W
Attorney at Law (Patents) McGill Bldg Washington D C
- Robartes, Leigh CE '09-----Shoreham N Y
Civil Engr Div Shipyard Plants Emer Fleet Corp Phila Pa
- Roberts, Fred W CE '17-----1471 High St Denver Colo
Supt The J Fred Roberts & Sons Constr Co 206 Tramway Bld
- Robey, Kennerly AM CE '95 1420 Boulevard Fort Worth Texas
Consulting Engineer and Geologist
- Robinson, Donald M CE '19 448 So Columbus Ave Mt Vernon
[N Y
- Robinson, George G CE '14-----Weedsport N Y
Mgr Lock Joint Pipe Co Ltd Toronto Ont Can
- Robinson, Horace B CE '74-----304 Orange St Oil City Pa
Retired
- Robinson, Horace B Jr CE '10-----1204 Crawford St Houston Tex
Civil Engineer The Texas Pipe Line Co
- Robinson, Melville W CE '15-----304 Orange St Oil City Pa
Cumberland Pipe Line Co Winchester Ky
- Rockwell, Fayette L CE '14-----392 No Main St Wellsville N Y
Vice-President & Treasurer Victor Aluminum Mfg Co
- Rodenhiser, Louis A AB CE '14-----MAAE Warner N Y
Asst Div Engr B & O RR Co 1819 E 65 St Cleveland O
- Rodhouse, Thomas J BS in CE MCE '05-----MSPEE 819 Virginia
Prof Hydraulic Engrg Univ of Missouri Columbia Mo [Ave
- *Rodriguez, Arturo CE '91-----MASCE 308 W Seneca St Ithaca
Constr and Contr Engineer Box 142 San Juan P R [N Y
- *Rodriguez, Francisco de P CE '78 51 Virtudes St Havana Cuba
Lighthouse Engineer Board of Public Works
- Roess, Gustav F CE '90-----309 W Third St Cil City Pa
General Contractor and Engineer
- Rogde, Sigurd CE '19-----216 Park Place Brooklyn N Y
- *Rogers, Alson CE '72-----MESPa 120 Pa Ave W Warren Pa
Borough Engineer
- *Rogers, Job R CE '06-----MRoES Holley N Y
Engr & Contractor 63 S Main St
- *Rogers, Theodore C CE '16-----172 First Ave Phoenixville Pa
Elect Engrg Dept Am Tel & Tel Co of 195 Bdwy N Y C
- Rohwer, Carl II CE '13-----704 Remington St Ft Collins Colo
Irr Engr U S Dept Agr Expt Sta
- Rollow, Thomas P Jr CE '09-----MAAE 419 W Henderson St
Assistant Division Engineer GC&SF Ry Cleburne Tex
- Root, Francis J CE '73-----600 West End Ave N Y C
Pres New York Wire Cloth Co 233 Broadway
- Rose, John K Jr CE '15 Provident National Bank Waco Tex
407 W Oak St Carbondale Ill
- *Rosenfeld, James R CE '15 5837 N Umlerland Ave Pittsburgh
Sp Agt E A Woods Co Eq Life Assurance Co Friek Bldg [Pa
- Rosenthal, Jules E CE '15-----Douglas Manor N Y
Sec-Treas Gretsck Engrg Corp 103 Park Ave N Y C
- Rosenzweig, Samuel CE '15-----
Civil Engr Pub Service Comm 143 W 40th St N Y C
- Rosser, David M CE '95-----167 S Maple Ave Kingston Pa
Engineer of Roads and Bridges Luzerne Co
- *Rossman, Clark G CE '93 MD-----339 Allen St Hudson N Y
Physician and Surgeon 11 So Sixth St
- *Rounds, Donald M CE '03-----708 Sixteenth St Des Moines Ia
- *Rountree, Albert C BS in CE '12-----Quitman Ga
County Engineer
- *Routh, James W CE '14 MASCE 101 Laburnum Crescent Ro-
Director Rochester Bureau of Municipal [chester N Y
Research Inc
- *Rue, Malcolm A CE '99 AMASCE R F D 3 New Brunswick N J
American Steel Co 49 Linia Vedado Havana Cuba
- Ruhl, David A CE '20-----1502 W 11th St Des Moines Ia
- Ruiz, Henry C See Williams, E Ruiz
- Rummele, Edward T CE '14-----Manitowoc Wis
Jeweler
- Runnette, Harry K CE '96-----2231 Dexter St Denver Colo
Civil Engineer
- *Russell, Robert C CE '17-----4158 Cleveland Ave St Louis Mo
Rutherford, Harry W CE '06-----Apt 609 1021 Pine St
Civil Engr 647 New York Bldg Seattle Wash
- Rutledge, Arthur E CE '86-----508 No Church St Rockford Ill
Contractor Mead Building
- *Ryan, Walter J AB CE '06-----MASCE Snoqualmie Wash
Civil Engineer Snoqualmie Falls Lumber Co
- Ryman, Lynde H CE '13-----183 No Laurel St Hazleton Pa
Asst Engr L V R R Div Engineer's Off Sayre Pa

- *Ryon, Henry CE '06 AMASCE 626 Flatbush Ave Brooklyn NY
N Y S Dept of Health Albany N Y
- St. John, Richard C CE '87-----85 Clinton St Brooklyn N Y
Div Engr N Y Municipal Railroad Corporation
- Sagal, Marcus CE '21-----1815 Linden Ave Baltimore Md
- Sanders, Daniel H CE '09 191 Forest Ave Tompkinsville N Y
Engr Mason Hanger & McArthur Bros 759 Metropolitan Ave
Brooklyn N Y
- Sanderson, Albert B Jr CE '16-----32 Westford Ave Springfield
Sales Engr Pittsburgh-Des Moines Steel Co [Mass
Pittsburgh Pa
- Sarstedt, Gordon A CE '15 MCIES 2352 Euclid Blvd Cleveland
Sec-Treas Genl Asphalt Pav Co Cleve Wax Paper Co [O
1000 Leader News Bldg
- Saunders, Walter L CE '17-----
Engr Cone Steel Co 42 Broadway N Y C
- *Savacool, William L CE '04-----74 Ray St Jamaica N Y
Civil Engineer and Surveyor Elmhurst N Y
- Sawyer, Thorp D CE '14 AMASCE c/o Mrs W P Tronbridge
[R D 1 Tacoma Wash
c/o Guggenheim Bros. Casilla 647 LaPaz Bolivia S A
- *Saxton, Wilbur S CE '07-----Baldwinsville N Y
Assistant Engineer New York State
- Seacieraferro, Salvador J CE '21 506 Highland Ave Clifton N J
- Searritt, Winthrop T CE '13-----1408 W 51st St Kansas City Mo
Asst Genl Mgr Pratt Chuck Co Utica N Y
- Schaefer, John J CE '21 116 Lincoln Ave Rockville Centre N Y
- *Schaefer, Rudolph F CE '10 730 Church St Richmond Hill N Y
Structural Designer 120 Broadway N Y C
- Schaetzle, Theodore A CE '13-----
Chemist-Bacteriologist Balto Sew Disp Plant Colgate
Balto Co Md
- Scheckel, William B CE '17-----943 St Johns Place Brooklyn N Y
Adams Evans Co 30 Church St New York City
- *Scheidenhelm, Fred W AR '05 CE '06 MASCE 10944 Hilburn
Cons Engr Mead & Scheidenhelm [St Hollis N Y
30 Church St N Y C
- Schein, Nathan CE '06-----AMASCE 1510 Carson St
Div Engr Bur of Engrg Pittsburgh Pa
- Shempff, Robert CE '20-----423 E 85th St N Y C
With Jobson-Gifford Co 30 E 42d St N Y C
- *Schindler, Harry CE '14-----
Sales Engineer 570 Penobscot Bldg [St Chicago Ill
Detroit Mich
- Schmeek, Henry P CE '11-----La Salle N Y
Jun Engr Panama Canal Box 225 Balboa Heights C Z
- *Schmidt, Elmer E F CE '12 MASME 345 Robinson St Bing-
Chief Engr Lone Star Gas Co Fort Worth Tex [hamton N Y
- *Schmidt, William H CE '94-----17 W 42d St N Y C
Retired
- *Schmied, Erich E CE '15-----224 Aisquith St Baltimore Md
Civil Engineer Morgan Engrg Co Memphis Tenn
- *Schoder, Ernest W BS PhD '03 AMASCE 220 Willard Ave
Prof of Hydraulics School of Civil [Ithaca N Y
Engineering C U
- Schoff, Frederic CE '71-----3418 Baring St Philadelphia Pa
Proprietor Stow Flexible Shaft Co 26th and Callowhill Sts
- Scholtz, Herman F BCE CE '06 AMASCE 1430 Cherokee Rd
Supt Newport Chemical Works Inc [Louisville Ky
Passaic N J
- *Schreiber, Leonard G CE '05-----626 June St Cincinnati O
Vice Pres & Genl Mgr L Schreiber & Sons Co Box 18
Evanston Sta
- *Schreiner, Alberto F CE '97-----MMunENY New York City
Efficiency Engr Comm of Accounts 2500 Municipal Bldg
- Schroeter, Robert H CE '20-----417 E Center St Marion O
Carroll Electric Co 1734 K St N W Washington D C
- *Schwalbach, Frank CE '88-----R D 8 Appleton Wis
Civil Engineer
- *Schwartz, Christian CE '14 2961 W Grand Blvd Detroit Mich
Testing Engineer Studebaker Corp
- *Schwartz, Samuel CE '14-----514 W 134th St New York City
Draftsman Dept City Transit Bourse Bldg Phila Pa
- *Seileppi, Francis P CE '17-----Pittsburgh Pa
Appr McClintie-Marshall Constr Co Y M C A Pottstown Pa
- Seagrave, Clarence N CE '12-----Gooding Ida
Mgr Presto-O-Lite Battery Ser Sta & Elect Conlr
- Seaman, Daniel H CE '08 AMASCE 17 Demarest St Newark
Str Engr D Everett Wald 1 Madison Ave N Y C [N J
- Seaman, Van Brunt CE '20-----662 Elmore Place Brooklyn N Y
- See, Russell A BS in CE MCE '14-----Montgomery City Mo
Asst Engr U S Reclamation Service Morrill Neb
- Seeley, Henry A CE '07-----2307 Morris Ave New York City
Room 1107 73 Tremont St Boston Mass
- Seely, Homer R CE '19-----1519 Green St Harrisburg Pa
Res Engr Bethlehem Steel Bridge Corp Box 351 Cape May NJ
- *Seelye, Elwyn E CE '04-----MASCE
Seelye & Fraser Cons Engrs 101 Park Ave New York City
- Seifried, Charles F CE '09-----2820 Reed St Cheyenne Wyo
Chf Drftsmn Wyoming State Hwy Comm
- *Seipp, Clarence T CE '09-----2340 Lincoln Park W Chicago Ill
Sec-Treas Mueller Construction Co Gen Contrs
- Selby, Frank S CE '13-----MACHEM 1300 North 52d Ave
Real Estate & Insurance [Omaha Neb
- Selec, Richardson CE '21-----146 Smith St Portchester N Y
- *Sellstrom, Elmer W CE '07-----611 Jefferson St
Supt Dahlstrom Metallic Door Co Jamestown N Y
- de Sena, Luis AB CE '08 MCuSE Calle 13 esq a 6 altos Vedado
Asst Engr R R Comm Havana Cuba
- Senior, Frank S CE '96-----MAAE MASCE Montgomery N Y
Vice-Pres Arthur McMullen Co 149 Broadway N Y C
- *Sessler, Marcel K CE '13-----271 Central Park West N Y C
Pres American Spike Co Inc 71 West 35th St
- Severson, Oscar M CE '01-----AMASCE Belfast N Y
Constructing & Contracting Engineer
- Sewell, Oscar J CE '19-----Olive Hill Ky
Engineer 1187 Central Ave Memphis Tenn
- Sexton, Joseph M CE '15-----169 W 98th St New York City
- Shae, Shao-ying D CE '10-----AMASCE Peking China
Co-Director Ry-Thru-Traffic Admn No 3 Koa Toa W City
- Shafer, James C F CE '05-----AMASCE 6110 Euclid Ave
Vice-President Boldt Construction Co Cleveland O
- *Shaw, Walter K CE '13-----132 23d St Elmhurst N Y
Mgr Cost Dept Turner Constr Co 244 Madison Ave N Y C
- Shelfon, Murray N CE '16-----617 Central Ave Dunkirk N Y
- Shen, Moo T CE '11 MCE '12-----Nanking China
Dean Nanking School Rys & Mines New Range Road
- Sherk, Earl J CE '21-----1849 Regina St Harrisburg Pa
- Sherman, Charles W SB MCE '95 MAWWA MASCE Belmont
Mem Firm Metcalf & Eddy 14 Beacon St Boston Mass [Mass
Sherman, Walter J CE '77-----MASCE 2243 Scottwood Ave
Cons & Desng Engr 616 The Nasby Building Toledo O
- *Sherwood, Nial CE '08-----AMASCE Liberty N Y
Asst Supt The Foundation Co
- *Sherwood, Wakeman F CE '13 27 Murray St Binghamton N Y
Draftsman Erie R R Co 50 Church St N Y C
- Shing, Shao C CE '17-----Chengtu China
Draftsman N Y C R R Co Grand Central Term N Y C
- *Shipman, Linn D CE '14-----556 First Ave Astoria N Y
- Shipman, Samuel S CE '19-----229 E 26th St Brooklyn N Y
Estimator 37 So Ninth St
- *Shire, Moses S CE '00-----Chicago Ill
A. G. Becker & Co 137 So LaSalle St
- Shirey, Lacy L CE '20-----JASCE Union W Va
Asst on Engr Corps C C C & St L R R Indianapolis Ind
- Shreve, Ralph F CE '06-----AMASCE 294 Tuxedo Ave
Str Engr Power & Constr Dept Ford Motor Co Detroit Mich
- *Shumway, Arthur K CE '04-----44 Electric Ave Rochester NY
Engr & Contr Reinforced Concrete Constr 16 State St
- *Sielino, Louis J CE '07 AMASCE 211 Broad St Red Bank N Y
Genl Engrg Contr 46 W 24th St Room 1819 N Y C
- Silsbee, James A CE '07 AMASCE 913 W Water St Elmira N Y
561 Washington St N Y C
- *Silverman, Aaron CE '02 1501 No Bentall St Baltimore Md
Manufacturer 423 W Baltimore St
- Silviera, Fernando X da CE '96-----Monte Santo Minas Brazil
- Simpson, Robert H CE '96-----1748 Summit St Columbus O
Engr in Charge of River Channel Improvement City Hall
- *Skinner, Frank W CE '79 MASCE 74 Central Ave Tompkins-
Asso Ed of Public Works & Cons Engr [ville N Y
243 W 39th St N Y C
- Skinner, John A CE '01-----946 Greytor Rd Cleveland O
Asst Engr Val Dpt N Y C R R Crown Bldg
- *Skinner, John F CE '90 MASCE 21 Arnold Park Rochester
Cons Engr & Prin Asst City Engr 52 City Hall [N Y
- Slater, Joseph N CE '03-----Winchester Ky
Engr Endfire Nat Gas & Fuel Co
- *Sloane, George G CE '12-----1733 T St N W Washington D C
- *Sloat, John A CE '08-----Clyde N Y
Sloat & Sloat Autos & Farm Machinery
- *Smallman, Ralph A CE '08 MCE '09 AMASCE Terrace Court
Vice-Pres & Treas Smallman Brice [Apt Birmingham Ala
Constr Co Inc
- Smith, Alger J CE '20-----Reynolds Ave Corning N Y
- Smith, Arthur L CE '11-----Selma Ala
Division Engineer State Highway Dept
- Smith, Benjamin L CE '14-----AMASCE 616 Munsey Bldg
Desng Engr Norton Bird & Whitman [Baltimore Md
- *Smith, Charles E CE '13-----Lock Box 18 Manchester N Y
- Smith, Dietz A CE '13-----313 E King St York Pa
Hydraulic Engineer S Morgan Smith Co
- Smith, Eugene L CE '12-----444 Marine Trust Bldg Buffalo N Y

- Smith, Eugene R CE '77-----MASCE Islip N Y
Civil Engineer & President First National Bank
- Smith, George G CE '98 MCE '99---Algerine St Stanley N Y
Farmer
- Smith, Harry C CE '07-----150 Greenwood St Canistota N Y
Sen Asst Engr Cayuga-Seneca Barge Canal Clory Bloek
Seneca Falls N Y
- Smith, Henry E CE '06-----644 Maryland Ave Bellevue Pa
- Smith, John W BArch CE '12-----1500 Park Ave Baltimore Md
With Norton Bird & Whitman 616 Munsey Bldg
- Smith, Joseph E CE '20-----818 Cleveland St Durham N C
- Smith, Lawrence R CE '07 350 Tremont St No Tonawanda N Y
Mgr Wholesale Dept Ray H Bennett Lumber Co
- Smith, Leonard J CE '92-----MECIPh 2430 Fairmount Ave
Div Engr Phila Rapid Transit Co Philadelphia Pa
- *Smith, Marion deK Jr AB CE '01 AMASCE 6 Wash Ave
[Chestertown Md]
- *Smith, Miller A CE '71 MASCE 235 Lincoln Rd Brooklyn NY
Cons Engr Smith Ames & Chisholm 508 Lonja Bldg Havana
Cuba
- *Smith, Stephen H CE '13-----Sherburne N Y
Chief Engr I W Jones & Co Milton N H
- *Smith, Theodore L CE '16-----49 Meyers St Forty Fort Pa
- Smith, William C CE '85-----Minneapolis Minn
Swan River Log Co
- Sneekenberger, Earl M PhB CE '05-----MAAE Billings Mont
City Engineer City Hall
- *Snider, Clarence A CE '91 Beechmont Park New Rochelle N Y
Secy & Treas The Union Sulphur Co 17 Battery Place N Y C
- *Snively, William J CE '16-----Chicago Ill
Cost Engineer 645 No Michigan Ave
- Snow, Arch M CE '06-----44 Elm St Malone N Y
Engineer Court House
- *Snyder, Charles H CE '02 AMASCE 170 W 4th St Oswego
City Engineer City Hall [N Y]
- *Snyder, Howard H CE '13 725 E Twelfth St Brooklyn N Y
Asst Engr & Supt of Cons R Carvel Co Inc 531 E 138th St
N Y C
- *Sobel, Julius CE '16 MAAE 135 Vernon Ave Brooklyn N Y
Sales Dept Ames Emerieh & Co 111 Broadway N Y C
- *Soman, Philip E CE '17-----34 W 112th St New York City
- Sorokin, Marcus CE '20 JASCE MAAE 69 Kosanski Kostoff-
[on-Don Russia]
- *Sourwine, James A CE '12 AMASCE 426 G St San Bernardino
e/o Bureau Public Roads Washington D C [Calif]
- Souza, Antonio C P CE '14---Rua Helvetia 31 Sao Paulo Brazil
Railway Engineer
- *Spalding, Lawrence CE '13---MAREA MARB&BA Box 243
Asst Val Engr Besemer & Lake Erie R R Greenville Pa
- *Spamer, Morris A CE '13 929 1/2 Oak Hill Ave Hagerstown Md
Manager Joseph Brenner & Co Barksdale Wis
- Spandan, Harry M CE '09 MCE '10-----607 Flatbush Ave
Asst Ind Engr 55 Liberty St N Y C [Brooklyn N Y]
- *Sparfield, Emil H CE '12-----175 St James Pl Buffalo N Y
Asst Production Mgr American Chain Co Bridgeport Conn
- *Spear, George P Jr CE '16---186 Bloomfield Ave Passaic N J
Asst Engr N Y Tel Co 104 Broad St N Y C
- *Speelht, Harry G CE '13-----335 E 68th St New York City
Ind Engr Bessick Co 574 E Ferry St Newark N J
- *Spelman, Harold J CE '10 MAAE AMASCE Huntington W Va
Div Engr State Road Comm 107 Robson Prichard Bldg
- Spelman, William A CE '08-----Champlain N Y
- *Spence, Thomas R CE '17-----College Sta Tex
Supt Surplus Federal Equipment State Hwy Dept Austin Tex
- Spencer, Clifton B CE '94 2914 Linwood Blvd Kansas City Mo
Val Engr St Louis-San Francisco Ry St Louis Mo
- *Speyer, Elwin G CE '07 MASCE 1509 Seneca St Buffalo N Y
Cons Engr 801 Chamber of Commerce
- *Spiker, William C CE '00 MASCE MAAAS 33 E Fourth St
Cons Engr 570 Forsyth Bldg Atlanta Ga
- Spivak, William CE '20 JASCE 194 Thatford Ave Brooklyn
N Y
- *Spivey, Willis T BS in CE CE '10---AMASCE Greenville Ga
Mat Handling Engr W T Spivey & Co 112 So 16th St
Philadelphia Pa
- *Spragins, William E CE '08---Univ Club Salt Lake City Utah
Wholesale Store & Range Bus 702 Walker Bank Bldg
- Sprague, Danley DCE '95 MAAE 1131 Balboa St San Francisco
Str Engr Val Dept I C C Wells Fargo Bldg [Calif]
- *Sprague, Frank D CE '11 15 Greenway Terr Forest Hills N Y
- *Sprigg, C Crawford CE '07 AMASCE 15 Central Ave St
Pres Gen Contrg & Engrg Co [George Staten Isd N Y
29 Broadway N Y C]
- *Squire, Walter L CE '10---Lewiston Road Niagara Falls N Y
Niagara Falls Power Co
- *Stahl, John J CE '12-----315 Manning Blvd Albany N Y
Hwy Engr Bur Pub Roads 301 Custom House Bld Denver Col
- Stalford, J Alfred CE '10 AMASCE MECIMd 3217 Carlisle Ave
Gen Mgr Bldg Dept Consol Engrg Co 243-59 Calvert Bldg
Baltimore Md
- Stalker, John H CE '20-----9 James St Montclair N J
- *Standford, Harry R CE '10---1229 L St N W Washington D C
Constr Supvr J G White Engrg Corp 43 Exchange Pl N Y C
- Stanton, Grove A CE '07---MPNWSE R F D 9 Auburn N Y
- *Stanton, Robert B Jr CE '09 AMASME 7 Christopher St NYC
Sales Engr U S C I Pipe & Foundry Co.
- *Stapley, Edward R CE '14-----32 Oak St Geneseo N Y
Secretary Geneseo Auto Co
- *Starkweather, Alfred K CE '12 AMASCE 65 Grand View Ave
Engr N Y Tel Co 15 Dey St N Y C [Plainfield N J]
- Starr, Charles F CE '15 MRoES 64 Rowley St Rochester N Y
Str Engr Genesee Bridge Co Inc 666 Plymouth Ave
- *Stearns, Fred L CE '10-----AMASCE Norwich Conn
Asst Engr Am Bridge Co 30 Church St N Y C
- Stearns, John CE '06 AMASCE 446 Ocean Ave Brooklyn N Y
Constr Supvr J G White Engrg Corp 43 Exchange Pl N Y C
- Stebbins, Smith H CE '95-----590 E 19th St Brooklyn N Y
Assistant Chief Map Division Hall of Records
- Steel, Ernest W CE '20-----Maple Shade N J
- *Steele, Gilbert V CE '10-----245 State St Flushing N Y
Corrugated Bar Co 17 Battery Place New York City
- Stegner, Cliff M BS CE '00 MASCE MAIArch 3455 Cornell Pl
Stegner & Hughes Archs & Engrs 1012 Com Trib Bldg
Cincinnati O
- *Stein, Myer CE '17-----508 Elton St Brooklyn N Y
- *Steinaeher, Gustavo J CE '92---214 Cathedral Parkway N Y C
Chief Engr Dept of Parks Bor of Manhattan N Y C
- *Steljes, Martin CE '15-----1419 Clinton Ave New York City
- *Sterling, Guy CE '87-----MASCE 1579 E Ninth So St
Cons Engr 1115 Newhouse Bldg Salt Lake City Utah
- Stern, Jeno CE '21-----222 E 96th St New York City
- Sternbach, Jacob J CE '21-----968 Tiffany St New York City
- Stevens, Harold B CE '02-----Masontown Fayette Co Pa
Field Engr Carnegie Steel Co Clairton Pa
- Stevens, John H CE '08-----AMASCE Rome N Y
Village Engineer Massena N Y
- *Stevenson, Albert L CE '13---4910 Arch St Philadelphia Pa
With Seelye & Fraser Cons Engrs 101 Park Ave N Y C
- Stewart, Charles G BS CE '12-----MAAE Box 612 Flora Ill
Asst Div Engr Ill Div B & O R R
- Stewart, Clinton B CE '90---AMASCE MWSeE 1709 Adams St
Cons Hydr Engr 2321 Rowley Ave Madison Wis
- *Stewart, David B Jr CE '09 2601 No Charles St Baltimore Md
Asst Supt Raymond Cone Pile Co Sparrows Pt Md
- Stewart, Walter P CE '07-----1212 E Ash St Portland Ore
e/o Alexander Hamilton Inst 13 Astor Pl New York City
- Stiholt, Victor A CE '11-----532 W Seventh St Davenport Ia
Natalbany Lumber Co Ltd Hammond La
- *Stidham, Harrison CE '91 AMASCE MWaSE 3322 Newark St
Wilkins Bldg Washington D C
- Stine, Charles R CE '96-----
- Stirling, Vincent R CE '05-----e/o H P Short Oroville Calif
- Stoekdale, Thomas R CE '07-----Summit Miss
Civ Engr with Gardner & Howe 76 Porter Bldg Memphis Tenn
- Stolz, Albert F CE '19-----500 Wilmac Bldg Minneapolis Minn
Provincial Mgr Merchants Casualty Co Toronto Ont Can
- Stone, Don O CE '09-----2410 Indiana Ave Columbus O
Maintenance Engineer State Highway Dept
- *Stone, Edward C CE '02-----Route 2 Box 30 Gardena Calif
Brokers Agent
- Stone, George C CE '11-----AMASCE Altavista Va
Engineer Lockwood, Greene & Co of Boston Mass
- Stone, James S CE '89-----516 Grimes St Sewickly Pa
Checker American Bridge Co Ambridge Pa
- *Stone, Morris CE '15-----38 Lincoln Ave Amsterdam N Y
Stone's Toggery Shops
- Storey, Frank S CE '02-----AMASCE
e/o The Phoenix Constr Co 41 Park Row New York City
- Storey, William R CE '81---MRoES 30 Hortense St Rochester
Civil Engr and Surv 510 Ellwanger & Barry Bldg [N Y]
- *Storz, Joseph F CE '06---35 Wyoming St Wilkes-Barre Pa
Maintenance of Way Dept Lehigh Valley Railroad
- Stott, Charles A CE '19-----3167 17th St Washington D C
With Chas G Stott & Co Inc Paper & Stationery
- Strahan, Joseph C J CE '13---210 W 90th St New York City
- Strang, Percival CE '97---Colonnade Apts Indianapolis Ind
Gen Supt The Dunn McCarthy Co 520 Old Colony Bldg
Chicago Ill
- Strasburger, Edgar J CE '00-----303 So Idaho St Butte Mont
Strasburger Civil and Mining Engrg Co 614 Daly Bank Bldg

- *Stratton, William H CE '88--194 Prospect St Ridgewood N Y
Mgr Br and Bldg Dept U S Steel Prod Co 30 Church St NYC
- Strong, Herbert W CE '94--1939 E 90th St Cleveland O
See The Strong Carlisle & Hammond Co 1392 W Third St
- Strumer, Samuel CE '17--1384 Bristow St New York City
Fouquier Concrete Co 29 Broadway
- Stuart, Thomas M CE '15--149 Summer Ave Springfield Mass
Industrial Engineer 648 Fulton St Troy N Y
- Stubbs, James H CE '76--Fort Morgan Colo
Civil Engineer
- *Sturdevant, James H CE '05--AMASCE Poughkeepsie N Y
Div Engr N Y State Hlghway Commission
- *Sullivan, John G CE '88 MASCE MEIC MAREA 207 Harvard
Cons Engr 703 McIntyre Blk Winnipeg Manitoba Can [Ave
- Sullivan, Michael G CE '21--334 Garson Ave Rochester N Y
- *Sullivan, Philip L CE '18--11 Loring Hall Springfield Mass
Maintenance of Way Dept L Y R R Buffalo N Y
- Summers, Richard E J CE '14 AMASCE 508 McNair Ave Wil-
Asst Ch Engr II K Ferguson Co Cleveland O [kinsburg Pa
- *Summers, William F CE '14--144 Queen St Ithaca N Y
With Edward Sprigg Contractor & Builder
- *Sun, Taoyuh C CE '09 AMASCE 15 Pekin Rd Shanghai China
Mang Dir Chuechow-Chinchow Ry Tur-farr Hutung Peking
China
- Sun, Yu-fong CE '18--JASCE 2 Taku St Tientsin China
See Engr Peking Suiyuan Ry Tur-farr Hutung Peking China
- Sundstrom, Charles A Jr CE '21--176 Wisner Ave Middletown
[N Y
- *Super, Stanley L CE '12--2047 W Ontario St Philadelphia Pa
75 Sixth St Pottsville Pa
- *Supplee, George W CE '15--Haddon Heights N J
Supt Ore Docks 2821 Richmond St Philadelphia Pa
- Sutton, Paul B CE '12--818 Academy St Watertown N Y
City Engineer
- Swanitz, Henry W CE '00--AMASCE
Hydr Engineer 546 Georgia St Vallejo Calif
- *Swerdlove, Louis CE '17--MAAE 1384 Prospect Ave
Jun Engr Room 606 39 Whitehall St New York City
- Swick, Charles H CE '10--Livonia N Y
99 Cannon St Poughkeepsie N Y
- *Swiek, Clarence H CE '07--Capitol Heights Md
Geodetic Computer U S C & G S Washington D C
- Swindells, Joseph S CE '95 MCE '98--MASCE 1090 18th St
Cons Engr Room 1110 111 Broadway N Y C [Brooklyn N Y
- Swinney, Robert E CE '08--Mobile Ala
Field Engineer Chickasaw Shipbuilding Co
- *Symonds, George R B CE '09 AMASCE MSAmE 39 Wayne Pl
Town Engineer Nutley N J
- Tan, Vidal A AB MA '18 CE '18 469 Salsipuedes Manila P I
Civil Engr and Instr University of the Philippines
- Tang, Cheng Long CE '21--Tang's Villa Kishup Hup Hupeh
[China
- Tate, Robert L H CE '12 MAAE AMASCE 219 Linden Ave
[Ithaca N Y
- *Taussig, J Wright CE '08--AMASCE 468 Riverside Drive
Asst Gen Mgr Raymond Concrete Pile Co 140 Cedar St NYC
- Tavares, Juan T CE '18--Santiago Dominican Rep
Engineer Tavares Soes Builders
- *Taylor, Albert M CE '15--Athens Ave Ardmore Pa
- Taylor, Clinton L CE '12--Wyalusing Pa
Agriculture
- *Taylor, Edward H BS CE '12 Care C & P Tel Co Roanoke Va
Engineer Austin Co 1566 Hanna Bldg Cleveland O
- Taylor, Robert C CE '99--620 Mellon St Pittsburgh Pa
Supt Lucy Furnaces Carnegie Steel Co
- *Taylor, Roy CE '10--455 Greene Ave Brooklyn N Y
Munson Steamship Co 82 Beaver St New York City
- Taylor, Royden J BE CE '03--1224 Candler Bldg Atlanta Ga
Civil Engineer 644 Wayne Ave Indiana Pa
- *Taylor, S Leroy CE '13 3529 Columbus Ave Minneapolis Minn
Sen Hwy Engr U S Bur Pub Rds 410 Hamm Bldg St Paul
Minn
- *Tavlor, Thomas U CE MCE '95--MASCE San Antonio Tex
Dean of Engineering Univ of Texas Austin Tex
- *Taylor, T Walter CE '00 1424 W 35th St Oklahoma City Okla
Assistant General Manager Fontana Oil Co 424 Lee Bldg
- Taylor, William R CE '03--1257 Dean St Brooklyn N Y
Thos F Taylor's Sons Inc Coal 588 Kent Ave
- Tehan, Joseph J CE '09--4 Sheridan St Auburn N Y
Assistant Engineer L V R R Co
- Tempest, Richard C CE '09 163 Albermarle Ave Rochester N Y
- *Ten Hagen, Henry CE '13--AMASCE High Falls N Y
Co Engr N Y State Hwy Comm Warsaw Wyoming Co N Y
- Tenney, Maynard A CE '98--1049 E 18th St Brooklyn N Y
Inspector Subway Construction Philadelphia Pa
- Terrazas, Federico CE '16--220 Western Blvd El Paso Tex
743 Maple Lane Sewickley Pa
- Terrell, Adelphus C CE '00--Macon Mo
Div Engr on Val N P Ry Seattle Wash
- Thacher, Cornelius S CE '78--MAAAS Clifton Springs N Y
Professor Mathematics Retired
- Thatcher Romeyn Y CE '09--1077 Elmwood Ave Buffalo N Y
Civil Engineer Lackawanna Steel Co
- Thebaud, John E CE '95--234 Parker Ave Buffalo N Y
Engr and Patents 607 Otis Bldg Philadelphia Pa
- Thiele, Claude M CE '11 1472 Kilbourne Pl Washington D C
Captain U S A Coast Artillery Corps Coblenz Germany
- *Thomas, Edward J CE '15 AMASCE 1002 W Lafayette Ave
Baltimore Md
- Thomas, Edwin R CE '09--Box 202 Warren R I
Constructor 801 Bay State Bldg Lawrence Mass
- Thomas, Howard CE '77--Stuart Fla
Retired
- Thomas, James B CE '04--122 Columbus St Elyria O
Assistant Vice-President The Garford Mfg Co
- Thomas, Joseph A CE '20--c/o Mrs B A Hosfeld Clark's
c/o J G White Management Corp Manila P I [Summit Pa
- *Thomas, Seymour P CE '72 c/o Phoenix Iron Co 49 William
Retired [St New York City
- Thomas, William C CE '01--210 Plummer Ave Emsworth Pa
Checker
- *Thomassen, Victor G CE '11--AMASCE 539 Madison St
Amer Br Co 30 Church St New York City [Brooklyn N Y
- Thompson, Alexander M CE '13--405 Plymouth Bldg
[Minneapolis Minn
- *Thompson, Chester A CE '16--158 Dana Ave Albany N Y
G & J Tire Co Indianapolis Ind
- Thompson, Elmer E CE '11 AMASCE 609 1/2 W Gray St Elmira
Draftsman American Bridge Co [N Y
- Thompson, Ewing CE '14--305 Third Ave Lewiston Ida
c/o Solvay Process Co Solvay N Y
- *Thompson, George R CE '17--41 Woolsey St Astoria N Y
- *Thompson, Hoxie H BS CE '05--Trinity Tex
President Thompson Bros Lumber Co
- Thompson, Karl F CE '14--Seneca Falls N Y
Asst Engr N Y State Hwy Comm 121 Seneca St Hornell
- Thompson, Wells N CE '21--8 East St Adams Mass
- Thomson, Alexander Jr CE '99 MASCE 104 No 22d St Orange
Dist Sales Mgr Concrete Steel Co 42 Broadway N Y C [N J
- Throop, Henry G CE '05--AMASCE 2117 So Geddes St
Supt for Contractor F J Baker Syracuse N Y
- Throop, William B CE '77--464 No Prairie St Galesburg Ill
Gen Supt Q O & KC and I & St L RRs
- *Thweatt, Hardin H CE '13--2020 E 90th St Cleveland O
Assistant Superintendent Van Dorn & Dutton Co
- Tier, Lewis P CE '74--10515 Bryant Ave N E Cleveland O
Car Dept N Y C R R Co Collingwood O
- *Tiffany, Nathan N CE '05--AMASCE East Hampton N Y
Civil Engr & Sur Mem Bd of Supervisors Suffolk Co Cashier
Osborne Bank
- *Tiffany, Nelson O Jr CE '01--214 W Ferry St Buffalo N Y
Pres & Gen Mgr Masonic Life Assoc Masonic Temple
- *Tillotson, Edwin H CE '17--100 Chandler St Detroit Mich
- Tilton, Benjamin CE '97 MASCE MAREA 18 Mason Place
Gen Mgr N Y State Rys 303 Gridley Bldg [Utica N Y
- Syracuse N Y
- Ting, Zung-Kun MCE '20 MSSCh Kun-Shan Kiang-Su China
- Todd, Clarence L CE '07 AMASCE 1111 Harvard St NW Wash
Mgr Wash Off Pittsburgh Des Moines Steel Co [D C
- Tolles, Frank C CE '05 AMASCE 265 So Columbus Ave Mt
Supt Bur Pub Works Akron O -- [Vernon N Y
- Tomlinson, Frank C CE '74--721 Park Ave Ironton O
c/o A G Simpson 800 Citizen's Nat Bank Bldg Los Angeles
Calif.
- Tompkins, George S CE '96 AMNFPA 40 Kilby St Boston Mass
Supt Eastern Off Firemen's Fund Ins Co
- *Tompkins, Howard C CE '03--819 Roland Ave Baltimore Md
Member of Firm R K Meade Co 13 E Fayette St
- *Toms, Raymond E CE '07--Frederick Md
Sen Highway Engr U S Dept Agriculture Chicago Ill
- *Torrance, Chester C CE '99 MCE '00 MCnSE Industria 100
Torrance & Portal Engineering Contractors [Havana Cuba
- Torrance, Robert S CE '16 165 Buckingham Road Yonkers N Y
The Southern Cotton Oil Co 1515 Broad St Augusta Ga
- *Towl, Forrest M CE '86 MASCE MASME MAIME Shelter Is
Pres Southern Group Pipe Lines 18 Broadway NYC [Its NY
- *Towle, John W CE '94--MOMTeeCl 3602 Pacific St
Pres Omaha Steel Works 348 Bee Bldg Omaha Neb
- Townsend, David W CE '15--25 Judd St Honolulu T H
- *Trask, Clarence H CE '12--R D 2 Fulton N Y
Pontiac Mich
- Trautwine, John C 3d CE '00 MASCE Box 6509 Upper Darby
Civil Engr Philadelphia Pa [Branch

- *Trimpi, Allen L CE '10 AMASCE 35 Stockton Pl E Orange
C E Dept Fed Shipbldg Co Kearney Pa N J
- *Tripp, Harry II CE '08-----Dryden N Y
Res Engr C P R R Edmonton Alberta Canada
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Assistant Engineer Chuchow-Chinchow RR Peking China
- *Tuller, Jesse D CE '09-----88 Branch Ave Red Bank N J
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Meeh Supt Gun Cotton Plant Noble Ont Can
- Turner, William J CE '07-----MAIME Lexington Va
Asst Gen Mgr Braden Copper Co Ranagua Chile S A
- Turrill, Sherman M BA CE '01-----703 South Ave Maywood Ill
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N Y C
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[Kiangsu China

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[N Y]
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1st Asst Supt 12th Lighthouse Dist 424 Federal Bldg
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ENGINEERING CONSTRUCTION LECTURES

Special lectures were delivered to the engineers May 23 and 24th on the water works of the great cities, modern tunnelling, concrete arches and on cofferdams by Frank W. Skinner, C. E., Cornell '79, Consulting Engineer, Associate Editor of PUBLIC WORKS. The lectures differed from those ordinarily given in the engineering course in that they were entirely free from mathematics, analyses, and design, giving only the conditions, requirements and advanced methods of executing great engineering work that students are taught in the class room to design. They were illustrated by numerous stereopticon slides of notable work in progress, giving graphical presentation of the difficulties and triumphs of the engineer and of the manner and appliances with which he won the victory. They were not intended for deep study or research, but were designed to interest students and others in the great importance of engineering construction and to point the way to the practical considerations that should be important factors in the safety and economy of the design. They show the work that the young engineers may hope sometime to emulate and are full of examples of great courage and ingenuities in which many Cornell men have won high laurels.

These lectures were hastily selected from a list of 40 and are the outgrowth of Mr. Skinner's life long specialization in civil engineering construction operations. The first lectures were prepared several years ago under the supervision of Dean Fuertes and a course of about 30 was developed and given with examinations for several years until Mr. Skinner's increasing responsibilities no longer permitted him to devote the necessary time to their preparation and delivery. The lectures of this course, groups of them or single lectures were requested by many other engineering colleges and universities and were delivered by Mr. Skinner at Yale, Harvard, Princeton, Columbia, Rensselaer, Brown, McGill, Universities of Maine and Minnesota and various other places. They were the first lectures of this character that were ever prepared for a sustained engineering course in the practical features of construction methods, plant, and

operations, although occasional sporadic lectures had been given by engineers or contractors who were deeply interested in special achievements of their own and from time to time described them at the invitation of different colleges. This course, was however, carefully prepared to cover the fundamental features of the different classes of work involved and presented its elementary principles and the governing conditions and requirements, showing the state of the art, the standards and methods developed and illustrating them with numerous typical examples of notable and important construction, rather than devoting them to any single construction or operation.

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THE JUNE LIST

(Continued from Page 159)

practice of including the names of the members of the Association in the annual Transactions was continued until 1907 when it was abandoned due to the change in date of publication of the magazine. In 1907 the old "Transactions" changed its name to the CORNELL CIVIL ENGINEER simultaneously with its change to monthly appearance. Ever since, the June issue of the CORNELL CIVIL ENGINEER has been devoted mainly to the publication of the list of members (graduate or alumni) of the Cornell Association of Civil Engineers. Twenty-eight years have elapsed since the first appearance of this list and the same reasons which prompted its first publication are still in force and are responsible for this twenty-ninth appearance of the June List.

The publication of the June List has been a success year after year. It has filled a long felt need of Cornell graduates and alumni. Many subscribers write in, and in renewing their subscriptions, tell us that they really get the magazine for the June List. To them it forms an invaluable reference, and a mine of information about the doings of their former classmates. Besides, it gives the very latest home and business address that we have been able to obtain for every graduate of this college.

But here is just where the difficulty comes in. Of late years we have obtained quite conclusive evi-

dence that the June List in some instances is not as up-to-date as it might be. Letters and magazines have been returned to us repeatedly after being properly addressed according to the address given in our June List. If your address is wrong or if you come across an address of one of your classmates which you know positively is wrong, don't sit back and point the error out to someone else, but write to us and let us know about it immediately. The first publishers of the June List did not have this difficulty to contend with because there were only three hundred names in the whole list, and the college being young away back in 1893 all the alumni of the college were young and took an active interest in communicating with their Alma Mater. But today the June List includes 2500 names of the Alumni of this college, many of whom have retired or have been away from Ithaca so long that they no longer take an active interest in what may be happening in the precincts of Lincoln Hall.

The correctness, accuracy and prestige of the first eight issues of the CORNELL CIVIL ENGINEER published during the college year depend almost exclusively upon the work of the Board of Editors and authors of the articles published; but the correctness and accuracy of the last issue of the year, the June List, depend wholly upon the cooperation of the Alumni of the Cornell University School of Civil Engineering.

Remember to leave your address at the Co-op.

The usual purpose is to secure the dividend paid next November. Three-fourths of the students ask to be put on our mailing list. Some for Books, some for gift articles and many for Cross Section Papers.

Cornell Co-op. Society

MORRILL HALL

ITHACA, N. Y.

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